D 301.81:35/8

UNIV. OF FLA. LIB. DOCUMENTS DEPT.
AUG 9 1985
U.S. DEPOSITORY

# Combat Crew

### Strategic Air Command

AUGUST 1985
★★★★

# INTERVENTION — THE KEY TO EFFECTIVE COMMAND, LEADERSHIP & SUPERVISION

Intervention, that is what command, leadership and supervision — **safety** — is all about. All too often daily operations become routine to the point of being nearly automatic. On one hand this is good — it means we have a well-oiled disciplined machine that gets the job done. Unfortunately, it may also mean our well-oiled machine is rubber stamping activities, some of which may deserve the supervisor's careful review and intervention. Supervisors should be experienced, knowledgeable and objective enough to recognize problem situations and intervene before damage or injury occurs. This is why we place senior personnel in leadership and supervisory positions. Whether it is the Wing Commander, Squadron Commander, Crew Commander or Shop Supervisor, it is imperative to consider the possible outcome of subordinate actions/decisions and take aggressive, positive action when required. The supervisor must develop a "forward looking" approach, anticipate the potential problems and take action to avoid the difficulty. Obviously this is a very general statement, but perhaps some specifics will clarify my point. Let us examine some mistakes that have caused problems in the past.

Recently, two crew chiefs replaced switch guards with an incorrect part. The supervisor questioned the installation but failed to take positive corrective **action.** Result — twelve and one-half million dollars damage and a valuable combat aircraft out of commission for almost a year. In another instance, an improperly marked hangar door control and lack of supervisory intervention directly contributed to a fatal mishap. A worker, between two hangar doors, pushed the button to "open" the doors. However, instead of opening, the doors closed, killing the member. The condition of an improperly marked control went unnoticed and/or uncorrected by supervisors working in the area. Perhaps they just "didn't have the time" or thought it "wouldn't cause a problem." Unfortunately, this failure to intervene cost an individual's life.

Twice in the last two years SAC has lost B-52s during low level activity. Although the specific circumstances of these mishaps were different, in each case the crew continued beyond their limits and the limits of the aircraft. There simply was not aggressive supervisory intervention in time to prevent the problem. The result — the loss of nine lives and two valuable combat aircraft. Needless human loss and loss of combat capability could have been prevented by timely appraisal of deficient acts or judgment.

Off-duty mishaps can also be prevented by supervisors. For example, a member finished work at 0700 on a Friday morning and that afternoon started driving on a 520 mile trip, stopping enroute to pick up a friend. Their destination was a Saturday football game; however, at 0200 the vehicle left the roadway, the driver and his passenger were ejected from the car and the driver was killed. The driver's activities during the day preceding are not known specifically; however, fatigue was definitely cited as a factor. Perhaps if the supervisor had heard of the plans, he/she would have intervened, advised against the trip and prevented this costly mishap.

These are only a few of the many examples I could draw on to illustrate my point. All are powerful lessons learned at great expense; however, we do not need more examples, we need commanders, leaders and supervisors who intervene and put safety first. The "do as I say, not as I do" axiom fails to encourage subordinates to put safety first. Supervisors, no matter what their title, must take the lead and aggressively seek out hazards and intervene to eliminate them.

Not the obvious extension cord across the stairs or bad brakes on a missile transporter–erector, but those hidden hazards we have gradually grown used to day by day. It is these insidious hazards that can hurt us. When we tolerate unsafe behavior on a daily basis it "rocks us to sleep." When a maintenance technician does not confirm common part numbers; when a crew continues in the face of adverse weather; when a navigator is absent for mission planning; when a member does not get sufficient rest prior to driving; and there is no incident, the next time we will be inclined to do the same thing without recognizing the inherent danger. The supervisor must be the strong link in the mishap prevention chain and recognize these situations.

I charge each one of you to put safety first. Why? Because injured people and wrecked airplanes are not an effective deterrent. In WWII we killed more crewmembers during training than in war. We cannot afford to do that in today's Air Force. Technology has given us some very complex and expensive weapons. With only 100 B-1Bs slated for service, we cannot afford to lose ten airplanes, or five or even one. Most importantly, we cannot afford to lose a single Air Force member. Your responsibility in actively seeking out hazards will often mean looking for the worst case, being a pessimist, and acting as the "devils advocate." After identifying problem areas, your job is just beginning. You must intervene and take positive corrective action to make certain we maintain mishap free operations. Do not be a rubber stamp supervisor. The payoff is enhanced mission effectiveness and greater deterrence. After all, the word supervision can be broken down into two words: super-vision. Use your "super-vision" to keep SAC safe and strong.★★★

Lt Gen K L Peek Jr      Commander, 8th Air Force

# Combat Crew

**GEN LARRY D. WELCH**
**COMMANDER IN CHIEF, SAC**

BRIG GEN GEORGE LEE BUTLER
INSPECTOR GENERAL

COL CHARLES J. WINGERT
DIRECTOR OF SAFETY

## STAFF

***EDITOR***
MAJ BOB NEIDRICK

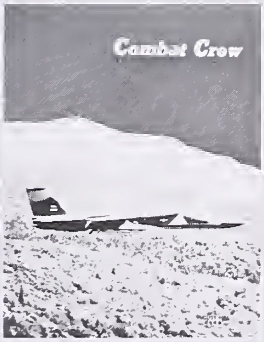
***ASSOCIATE EDITOR***
KEN MAASSEN

***ART EDITOR***
W.A. KIRKPATRICK

***EDITORIAL ASSISTANT***
M. J. ABBOUD

## IN THIS ISSUE

Swing Wing Geometry .......... 4
Heat Stress — You Can Survive It .......... 8
A Hundred Times Before .......... 12
Improve the Odds .......... 14
Cutting Edge .......... 17
SIFC Cross Check .......... 18
Safety Cross Feed .......... 24



## ON OUR COVER

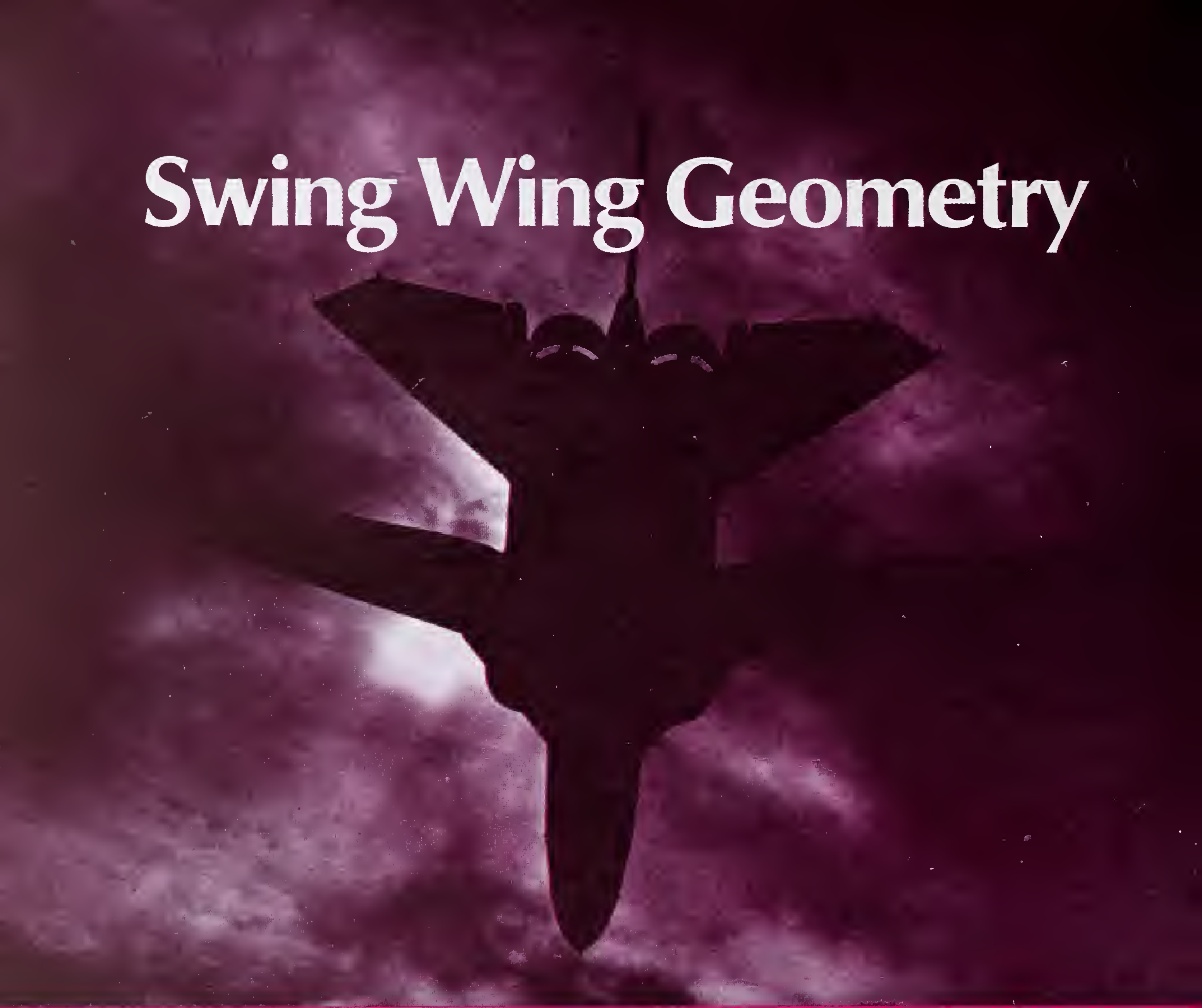
An FB-111A flying TFR. With the B-1B coming on line, SAC has two variable geometry bombers. For more on swing wing characteristics, see page four.

SACRP 127-1   VOL. XXXV   NO. 8   AUGUST 1985

**COMBAT CREW** is an internal publication of the Strategic Air Command with the primary purpose of promoting safety. The contents of this magazine are informative and not to be considered as directive in nature. Facts, testimony and conclusions of all mishaps printed herein may not be construed as incrimination under Article 31 of the Uniform Code of Military Justice. All names, dates and places used in conjunction with mishap stories are fictitious. Written permission must be obtained from Headquarters, Strategic Air Command before any material may be reprinted by other than U.S. Air Force organizations. Use of funds for printing this publication has been approved by Hq. USAF. Distribution FX, controlled by IGFE SAC units submit distribution requests through local PDO. Reader to copy ratio 10:1. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Contributions are encouraged as well as comments and criticism. Direct correspondence with the Editor is authorized. Address correspondence to Editor, Combat Crew, HQ SAC/IGFE Offut AFB, NE 68113, AV 271-2620.

# Swing Wing Geometry



Maj Ed Pearce
CFIC, Plattsburgh AFB

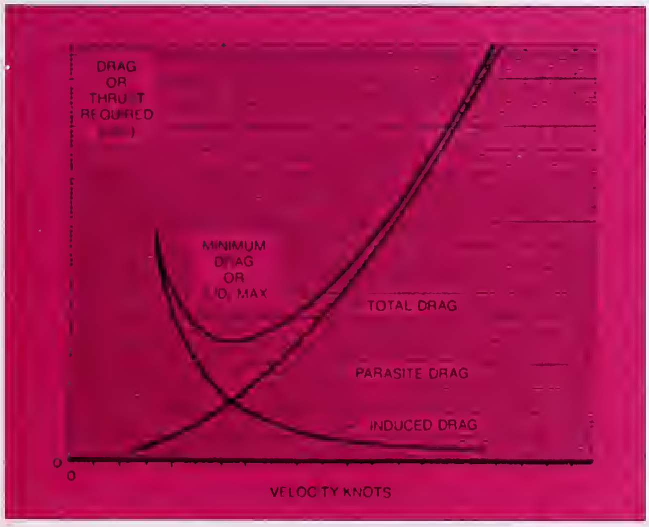
As the B1-B comes on line, the Strategic Air Command will have two variable geometry aircraft in the inventory. Since 1969, the FB-111A has earned an unparalleled record of success in competitions and readiness inspections, but there have also been many hard learned lessons in the safe operation of the variable geometry aircraft. Given the cost and limited number of SAC's newest swing wing bomber, these lessons must not be relearned.

One recurring theme highlighted in FB-111A mishap and incident reports is a need for constant review of basic aerodynamic principles unique to this type of aircraft. Instructors have the opportunity and responsibility to demonstrate and instruct these principles during several maneuvers described in SACR 51-111. Three of the demonstrations, High Speed Buffet, Wing Sweep Effects, and Approach to Stall and Recovery (clean and configured), will be discussed here. While performing the maneuvers, concentration should be placed upon how the aircraft responds to pilot input. A review of basic aerodynamics is important to FB-111A flight crews and will also introduce prospective B-1B crews to the joys of wings that sweep.

### What is Variable Geometry?

A variable geometry (VG) aircraft allows the pilot to select the optimum wingsweep position for varying flight conditions by changing the center of lift. In the B1-B and FB-111A, sweep is accomplished manually by the pilot. Remembering basic aerodynamics, an aircraft cuts through the atmosphere based on the principles of lift and thrust overcoming the forces of gravity (gross weight) and drag. As angle of attack (AOA) increases during decelerating flight, "induced" drag increases. Conversely, as AOA decreases while accelerating, "parasitic" drag increases dramatically. The total drag curve gives the optimum airspeed for that configuration (L/D Max). This principle is demonstrated in the chart below.

**(FIGURE 1)**

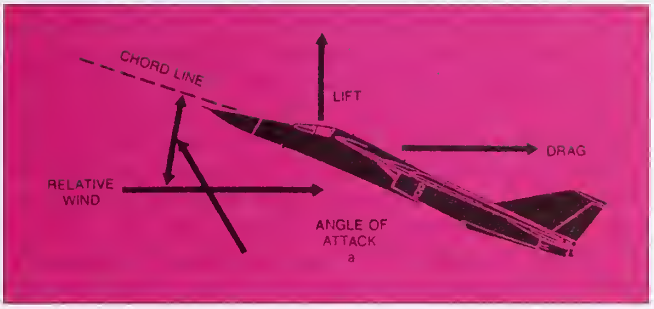


The VG aircraft can change L/D Max so that optimum performance can be constantly maintained at all airspeeds.

### Angle of Attack

Angle of attack is a critical factor in the production of lift: the angular difference between the chord line of the wing or lifting surface and the relative wind.

**(FIGURE 2)**

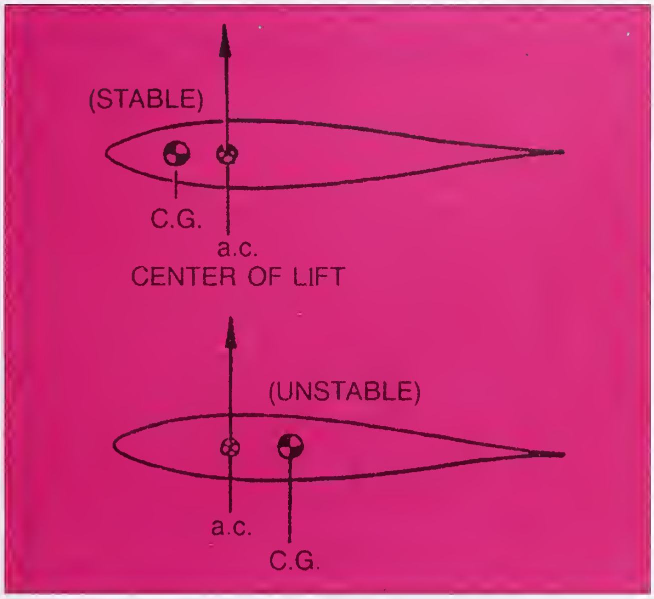


At low speeds AOA must be significantly higher to maintain lift. Correspondingly, as speed increases (with all other factors constant) AOA decreases. Wing sweep for takeoff and landing is normally full forward (16 degrees/FB-111A; 15 degrees/B1-B), with slats and flaps extended. High lift devices increase the wing camber allowing significantly slower maneuvering speeds in the traffic pattern. During climbout, flaps and slats are retracted at a rate not to exceed maximum angle of attack; the AOA indicator is the primary instrument for controlling AOA while raising the flaps and slats. Wings are then swept to the initial operation position of 26 degrees and further adjusted aft based on mission requirements. As the mission requires an increase in speed, angle of attack decreases on the 26 degree wing reducing its efficiency and increasing "parasitic" drag. Moving the wings aft as speed increases reduces drag and increases wing efficiency.

### Center of Gravity

An aircraft is able to maneuver in pitch because the center of gravity (CG) is forward of the center of lift (a positive static margin). A negative static margin is aerodynamically unstable.

**(FIGURE 3)**

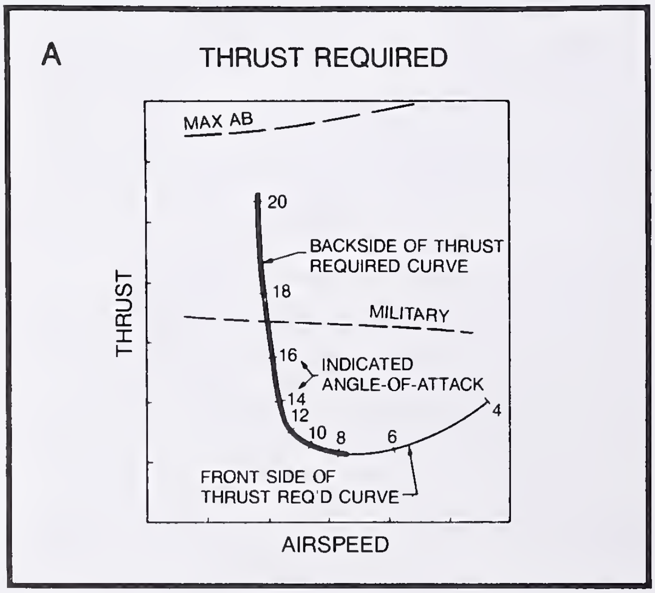


Although it is possible to change the center of lift on the variable geometry aircraft to compensate for a CG problem, maintaining CG within tech-order limits provides the aircraft predictable maneuverability at a wide variety of operating speeds. Aircraft CG in the FB-111A and B1-B is maintained primarily by fuel distribution. A discrepancy in aircraft CG would be reflected on the elevator position indicator (EPI). The EPI provides a direct readout of the amount of elevator being used to hold desired pitch attitude. The aft CG limit on a clean FB-111A is measured as 1 degree trailing edge up (2 degrees trailing edge up above .75 mach.) The forward CG limit is the maximum clockwise position on the gauge of 30 degrees trailing edge up. Should it become apparent from the elevator position that CG is moving aft, the wings must be moved in the same direction (aft) to maintain the positive static margin. Conversely, with a normal forward CG, wings must be moved to the full forward position before configuring to land. Should the wings be moved forward with an aft CG, static margin will decrease along with pitch stability, resulting in an uncontrollable pitch-up and loss of control. A modification to the B1-B will place a center of gravity warning light at pilot's eye level. The FB-111A has no warning light, however, so the key to CG control is fuel and store management, and incorporating the elevator position indicator in an effective crosscheck.

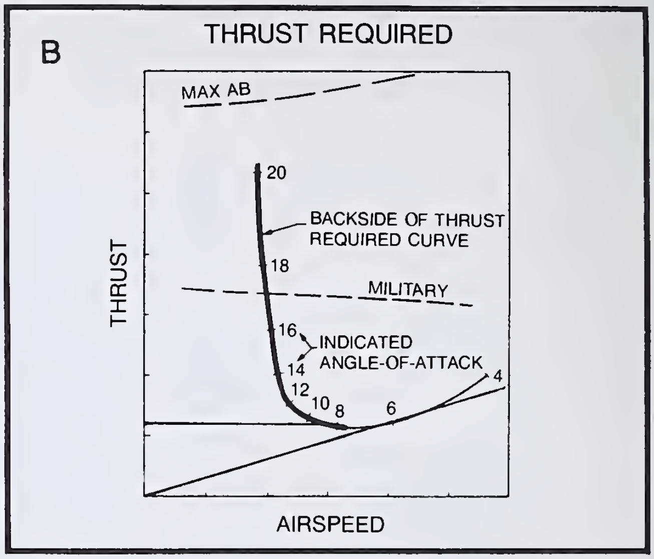
### Practical Applications

As stated earlier, by adjusting wingsweep the aircraft is allowed to perform at optimum AOA and at L/D Max throughout the flight regime. The FB-111A operates from approximately 125 kts to a speed of well over mach 2.0. Although the B-1B will be somewhat slower, it will perform similarly. The following graph depicts angle of attack for a representative wing position.

(FIGURE 4a)

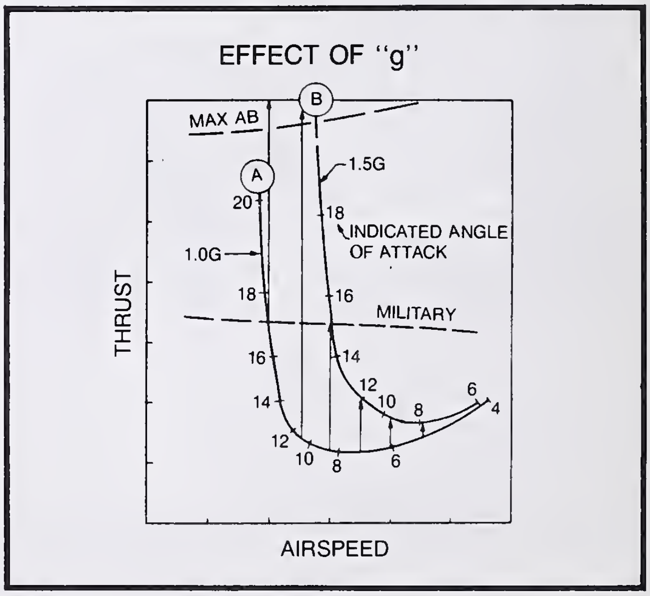


(FIGURE 4b)



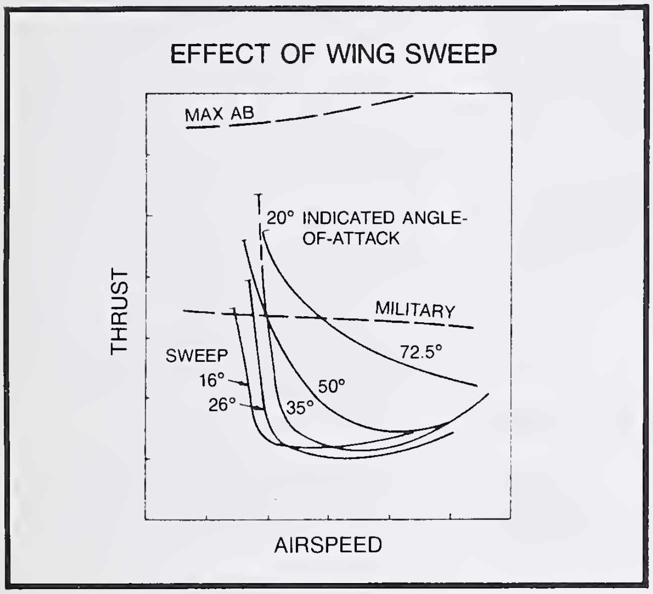
There are some interesting principles which can be determined by examining this chart. As airspeed decreases, angle of attack initially increases slowly, but then at a steeper rate until well past the point the aircraft can be recovered with thrust alone. There are other features significant to this AOA curve. By drawing a line from the origin tangent to the curve, the maximum range AOA is determined for that wingsweep. Maximum endurance AOA can also be determined from this chart by marking the lowest point on the curve. For years, FB-111A pilots have been sweeping their wings to maintain 4.5 AOA. As you can see, this figure is somewhat lower than the 5.5 AOA for max range taken from chart 4. Flying at this AOA is the generally accepted tradeoff between increased speed and decreased range; for the many advantages the higher speed has to offer, the small range degradation is a fair exchange.

(FIGURE 5)



On this chart, the effect of G on the lift/thrust curve is obvious; the aircraft will now go out of control or overshoot AOA limits at a significantly higher airspeed. Also notice that if the aircraft is operating at 9 AOA in level flight, rolling into a turn and pulling positive G's can cause an immediate overshoot of AOA limits.

**(FIGURE 6)**



As wingsweep moves aft the lift curve flattens out requiring significantly more thrust to maintain level flight.

### Demonstrating VG Principles in Flight

Maneuvers described in SACR 51-111 graphically demonstrates the principles discussed above. FB-111A instructors at the CCTS supervise the maneuvers frequently. Unfortunately due to higher priority training events they are practiced rather infrequently by crews in the bombardment squadrons. It is absolutely essential that the maneuvers be reviewed and practiced regularly, particularly before participating in challenging exercises such as Red Flag and Maple Flag. At these exercises crews are often called upon to max-perform the aircraft in the low altitude environment. It is vital that when performing the maneuvers, the pilot concentrate upon what the maneuver demonstrates and why, rather than attempting to fly it letter perfect. In an aircraft as aerodynamically complicated as the FB-111A or B-1B, there is very little margin for error in attempting to evade a missile or enemy fighter.

### Aerodynamic Buffet

When increasing speed at a fixed wingsweep, aerodynamic buffet occurs as smooth airflow is disrupted over the wing surface when airflow reaches a supersonic velocity. The sharp increase in parasitic drag is graphically depicted in chart 1 above. Onset of high-speed buffet varies with altitude and wing sweep. At forward wingsweep angles, buffet increases dramatically as load factors increase. With the wings fully aft (72.5 degrees), high speed buffet intensity is usually very light. High speed buffet can be reduced or totally eliminated by sweeping the wings aft until attaining cruise AOA. Low speed buffet, similar in feel to high speed buffet, is also caused by the disruption of airflow over the wings as the wing stalls. Traditional stall break is not experienced in the FB-111A since the body of the aircraft continues producing lift even after lateral stability is lost. Misreading low speed as high speed buffet can be catastrophic! Once again the AOA indicator must be monitored to determine the cause of the buffet. When practicing max-performance maneuvers, the pilot must rely upon his instruments rather than aircraft feel.

### Approach to Stall and Recovery

The FB-111A stall series described in SACR 51-111 is designed to demonstrate the characteristics of a stall and recovery in both accelerated and unaccelerated flight. The maneuver begins as AOA is allowed to increase from optimum cruise until the aircraft is on the back side of the power curve. The effects of command augmentation and the stall inhibitor system (SIS) during this demonstration are also vital to the maneuver. Command augmentation assists the pilot in maintaining desired G by varying elevator movement as flight conditions change. For example, the slower an aircraft travels the more the elevator must move to command 2 G's. With command augmentation, the pilot's stick feel is the same at low and high speed. (Think of this as power steering.) The first 59% of speed loss increases AOA by 3 degrees. As depicted graphically, once on the back of the power curve AOA increases rapidly as speed bleeds off so that in the next 36% of airspeed loss, AOA increases from 7 degrees to 17 degrees, or the point where military power would be required to recover. A further decrease in speed of 5% puts the aircraft in a regime where no amount of power alone will effect recovery.

Remembering the effect G input has on the aircraft, any overcontrol at high wing AOA can cause an immediate stall and loss of control. The SIS was added to the F-111 series after numerous mishaps were attributed to loss of control. The alpha limiter in the SIS computer now limits AOA by requiring increasing aft stick to maneuver above 11 degrees AOA. Command augmentation effectiveness is reduced until it is completely overridden by SIS. True wing AOA in one G flight is now limited to approximately 20 degrees. This modification provides the pilot invaluable feedback, but is not absolute protection since over-controlling the aircraft can still cause an overshoot of AOA limits.

Consequently, a WARNING in TO 1F-111(B)A-1 states that if a stall is permitted to occur, the critical and immediate action required is to REDUCE ANGLE OF ATTACK. For purposes of the demonstration, recovery is initiated at 18 degrees AOA clean or 14 degrees AOA configured. Unloading the aircraft to 2-5 degrees AOA, the AOA curve has moved to the left on the chart. Simply releasing the stick would allow SIS to unload

*Cont'd on page 26*

# Heat Stress — You Can Survive It!!

Maj Steve D. Doherty
7 BMW/DOC, Carswell AFB

The mission of the Strategic Air Command sometimes requires you to accomplish your flying duties in conditions where heat stresses can be encountered. These stresses can seriously compromise flying safety, mission completion and your personal safety.

There are dozens of bases in CONUS and nonCONUS locations that are notorious for year-around hot weather, and the nature of our aircraft compounds its effects. As they sit on the flight line baking in the sun, their cockpit temperatures can reach 120-140 degrees F or higher, thanks to the **"greenhouse"** and **"blackhole"** effects. Additionally, the ventilation systems on SAC aircraft are usually unable to handle this heat while on the ground.

Sometimes, while airborne, an aircraft air conditioning system will malfunction and try to cook you and your crew. This happened to a KC-135 crew operating from a southern base several years ago. It was mid-July and the flight line temperature was 105 degrees F, however, it was even hotter inside the tanker. After a one and one-half hour preflight and a 20 minute ATC delay they finally got airborne. Shortly after takeoff they were unable to position the air conditioning master switch to conditioned air, i.e., turn the heat off and the air conditioning on. As the aircraft climbed to altitude, so did the cockpit temperature. By the time the tanker leveled at FL 280 the cockpit temperature had reached 130 degrees F. Despite their discomfort, the pilots decided to continue to the ARCP and work the problem on the way.

One crewmember, the navigator, who had over 10 years of flying experience, had something else in mind. As he recalled, "I scanned the cockpit. I noticed that our 95 pound OMS passenger was nearly in a faint, and the boom operator was not in much better condition. The instructor navigator's face was as red as the training mission folder on my desk. Both pilots were irritable and frustrated because the master switch could not be reset. Things were rapidly getting out of hand." The navigator reacted in a manner that caught everyone's attention. "Pilot, nav," he said, "put the crew on oxygen before we all pass out . . . NOW!"

The use of 100% oxygen may have been the crucial reaction that saved this crew. Although only a temporary solution, the use of 100% oxygen does provide some relief from heat stress by simply cooling the face.

Next, the pilots decided to try the excessive heat elimination emergency checklist. All the while, they continued towards the air refueling area, despite suggestions from the navigator to abort the mission. Following their emergency procedures they decided to depressurize the cabin. Having forgotten about the OMS passenger, the pilots had to be reminded to descend to an altitude where oxygen would not be needed.

After the depressurization and subsequent level off at 10,000 feet the crew experienced their second problem. The instructor navigator was complaining of joint pain in his knees and elbows. The combination of the rapid depressurization and heat was causing symptoms of decompression sickness, or the bends.

When informed of the new development, the aircraft commander's only remark was a four letter word and a dirty look. He then called the IN forward for a one on one chat. His initial reaction was to continue the mission and complete the air refueling. To the veteran navigator this was the straw that broke the camel's back. "Pilot,

nav," he called over interphone, "AFR 60-16 specifically states . . ." The reminder was a quick lecture on AFR 60-16. Reluctantly the pilot aborted the mission and returned to home station.

As you can see from this example, the mental impairment and effect on good judgment was dramatically demonstrated to this crew. They were lucky.

There are some basic physiological facts about our body's ability to deal with heat that we as crewmembers need to know. The normal body temperature averages 98.6 degrees F. Heavy exercise can raise that temperature to 104 degrees F. A further rise between 105 and 111 degrees F, becomes extremely dangerous, with death from cardiovascular collapse or brain damage possible. A complicating factor is that the average man produces about 2000 calories of heat daily, which, if not dissipated, would raise body temperature to 190 degrees F. The bottom line is that heat loss must be equal to heat produced to prevent heat buildup.

Our body loses heat by four mechanisms: radiation, convection, conduction and evaporation.

Radiation simply involves the transfer of heat from a hot object to a cooler object by radiant energy. Convection and conduction are similar and both involve the direct transfer of heat by molecular motion from a hot object to a cool object in direct contact with each other. With these three mechanisms, the greater the temperature difference between the losing and gaining object, the greater the heat transfer.

As you would suspect, the effectiveness of radiation, convection and conduction as cooling mechanisms decreases as the surrounding temperature of the air mass increases. When the temperature of the air mass exceeds the temperature of the skin surface, the body actually gains heat. Our KC-135 crew quickly learned the truth of this principle!

As crewmembers, our most effective protection is evaporation of sweat and the associated loss of water vapor from the lungs. Production of sweat increases sharply from 82-84 degrees F. At 95 degrees F, the evaporation of sweat is responsible for nearly all the body's heat loss.

With these mechanics of heat transfer in hand let's see how the body deals with heat stress.

Heat stress produces a tremendous increase of blood flow to the skin, which transfers heat from the core of the body to the surface. The heat is then lost to the surroundings. Cardiac output increases to two or three times normal and the secretion of sweat reaches three to four quarts per hour. If this fluid is not replaced by drinking, the body will become rapidly dehydrated, the rate of sweat production will drop significantly, and the body temperature will rise. The victim will feel hot, tired, irritable, look pale, and may become nauseated. Finally, blood pressure falls, the brain receives insufficient blood and fainting occurs — called heat collapse or exhaustion.

**"Pilot, nav, put the crew on oxygen before we all pass out . . . NOW!"**

Most of these adverse physical effects can occur in aviation, with the exception of large changes in body temperature. However, a rise in body temperature to only 99.1 degrees F has been known to impair performance, especially when the rise in temperature was due to an illness. When relating increases in body temperature to decreases in performance, simple tasks are not affected. However, complex tasks are dramatically affected (i.e., flying an aircraft) and the number of errors may double when the body temperature reaches 101 degrees F.

A recent FAA study revealed that performance is impaired after only 30 minutes of exposure to cockpit temperatures of 95 degrees F. And in a cockpit of 120 degrees F, that time drops to below 15 minutes.

So, how can a crewmember avoid these effects? The best way is to become acclimatized to heat. Investigation of the crew discussed above determined that the navigator had acclimatized himself through frequent use of a dry sauna at a local health club, which dramatically enhanced his performance. In addition, he avoided dehydration by consuming two cans of Gatorade during preflight. The acclimatized crewmember is more comfortable, more energetic, and more efficient. The best way to develop acclimatization is through a systematic, sensibly progressive aerobic exercise program out of doors.

Other ways of reducing heat stress are to avoid coffee and the use of alcohol, which tend to reduce the amount of body water by stimulating the formation of urine. Also, avoid excessive exertion before a mission. Going to the gym for a workout, or doing your daily jogging prior to a flight is not recommended. If the going gets tough during a flight, a crewmember who exercised prior to flying may exceed his or her threshold of mental impairment or physical limits if severe heat stress is encountered. A crewmember can also loosen the flight suit during preflight, and delay donning of other personal equipment until just prior to taxi.

The steps to follow if cockpit temperature gets out of hand depend on the aircraft type and the exact problems encountered. However, there are some general guidelines to follow:

First, increase the cockpit ventilation, if possible, and direct any cool air to the face, head, and neck — the areas where heat is lost most efficiently.

Use 100% oxygen. Although oxygen is only a temporary solution, it can provide cooling to the face.

Consider aborting the mission, especially if the duration of exposure will be long.

Drink plenty of water to make up for the excessive amount of sweating. If enough water is available, dampen your flight suit. This will create evaporative cooling.

Resist the temptation to remove your personal equipment and clothing. Setting aside your helmet and mask, gloves, and lowering of your main flight suit zipper is as far as the crewmember should go.

You should also monitor yourself and your fellow crewmembers for heat stress symptoms. If you notice a deterioration in your performance or that of your crew, SPEAK UP. Be as assertive as necessary to gain attention. It may mean the difference between a mission well done, or **you** well done. Surviving heat stress means staying cool — literally and figuratively!

# THERE I WAS. . .

Capt Bob Dugan
93 AREFS, Castle AFB

The following story may very well sound like one of those "there I was . . ." yarns. But the incident is true, and hopefully will start some people thinking.

We had just finished a trans-Atlantic flight that had ferried a flight of F-15's on their way to bases in West Germany. We were now number two in a tanker cell heading for a recovery at RAF Fairford. Our lead KC-135 was out of Fairford and had met us in an overwater rendezvous. On board was an experienced crew on TDY. Aboard our aircraft, aside from our normal crew, were 21 passengers.

Things had gone very smoothly since joinup and through our flight southwards over the British Isles. I was particularly relaxed; as the number two navigator all I had to do was monitor lead's headings and keep his radar return on my scope. Because we were flying through broken clouds, keeping ourselves in position one mile in trail was my responsibility whenever we lost visual sightings of number one.

Because of different flight rules used in the United Kingdom, our cell was sharing a single flight level. This is a common way of assigning altitudes to cells in the U.K. when traffic saturation precludes the use of an altitude block. In this instance, our lead aircraft was flying 250 feet below the flight level, while we were 250 feet above.

As we approached the Fairford area, our cell was cleared down to FL 160. At that altitude we were in and out of the clouds. Since we were nearing the base, lead coordinated with our air traffic agency, Brize Control, for a high penetration. It was also arranged for us to contact Brize for our own approach request, an enroute descent to landing. Since cells are handled differently in England, cell breakup is more casual than the strict, positive act under CONUS FAA procedures. In anticipation of our cell breakup, we had coordinated with lead for our aircraft to increase the interval between our planes. I watched in the scope as we slid into a loose echelon position, two miles back and slightly to the right. We were both now in contact with Brize Control and it was here that events almost snowballed into tragedy.

Since our crew was preparing for a low altitude approach, we had not familiarized ourselves with the location of the high approach fix for Fairford. Because of this, we were unaware that our loosely formed cell was now a few miles from the high IAF, with lead planning to enter a right-hand holding pattern there.

At just about this time, in response to our request for an enroute descent, Brize issued us a clearance instructing us to descend to FL 060, take up a heading slightly right of our current cell heading, and to contact Fairford Approach. Our aircraft commander acknowledged the call and began the descent.

While we were responding to Brize's instructions, I watched the scope as lead's radar return began to close from two miles distance. He had started his right turn into holding.

I keyed the interphone and told the pilot, "Lead is turning in towards us at two miles."

Because he was initiating contact with Approach Control, the pilot cut out my interphone transmission. By the time I had finished my warning, lead had moved inside of a mile and was heading straight for the bright center of my scope; our aircraft!

I keyed the mike and more firmly called out lead's approach. Again I was cut out by our AC's contact with Fairford Approach. In desperation, I yelled across the cockpit, "He's turning into us!"

I had a sick, sinking feeling as I watched lead's radar return merge with the center of the scope, yet I was strangely calm and relaxed as I awaited the impact of our collision.

In response to my yell, the copilot turned to see what was wrong. As she turned, she saw lead pass by our left side at a distance, ". . . equivalent to the side by side parking separation on a normal ramp. One hundred feet at most."

**Again I was cut out by our AC's contact with Fairford Approach. In desperation, I yelled across the cockpit, "He's turning into us!"**

The navigator from the lead aircraft later said that no sooner had they initiated an evasive maneuver than they were rocked by the most severe turbulence he had ever experienced. They had gone right through our jet wash. All of this occurred in less than a minute.

As we continued our descent we heard our lead aircraft report the near miss to Fairford Approach Control. Flying on instruments, initiating a descent and talking with Approach, our pilot had not been aware of our near tragedy and asked, "I wonder who he almost hit?"

Our copilot, still shocked, replied, "It was us!"

On the ground, both crews filed the necessary reports and spent a good deal of time discussing what had almost been our last seconds on earth. There are several lessons to be learned from this experience; I will touch on some of the more obvious ones.

We all know that the approach and landing phase of flight is perhaps the most critical. As a result, increased attention and situational awareness are musts.

An early morning bus time, long overwater flight, and the excitement of deploying for an extended TDY are all contributing fatigue factors that must be overcome for a safe recovery. As a crew, our diligence was high, but extra attentiveness would have helped greatly.

Prior to deploying to an unfamiliar base, crews should study the field environment and be aware of the various approach profiles. Had we known the exact location of the high IAF, we could have anticipated lead's turn into holding.

Even though our cell wasn't joined until late in our flight, a modified "cell brief" should have been accomplished. This would have cleared up any questions there may have been about our individual intentions. It would have also facilitated a more positive cell breakup and made us aware of what position we should have taken to prevent a heading and altitude conflict.

Never assume anything. Being used to the strict radar controlled U.S. airspace, we were unaware that the British controllers do not normally take responsibility for cell breakup. As a result, our casual coordination for terminating the cell set us up for a potential disaster. As we later learned, Brize Control had been using skin paint for radar identification and assumed that "as a flight" we would be responsible for our own aircraft separation. For our part, when we received descent and vector instructions from Brize, we assumed that we were under radar control and that it was safe to comply with their instructions. As it happened, we descended through lead's altitude and across his flight path. Our falling back to a loose echelon position probably provided enough spacing to prevent a collision.

Finally, for navigators, watching another aircraft's approach on your radar scope does you no good unless you can communicate the danger to the rest of the crew. If your transmission is broken by other radios, go to the "call" position to get your message across. This goes for all crewmembers: the "call" position is for emergency use, not just preflight.

Increased vigilance, situational awareness, good inter-plane coordination, and aggressive reaction to danger will help to prevent this type of incident from occurring again. I should know, because **"there I was . . ."**

# A Hundred Times Before .

Capt A. Burnett
Lt A. Dixon
644 BMS, K. I. Sawyer AFB

There we were . . . isn't that how all these articles begin? Well, anyway there we were starting a typical mission planning day. Everyone enters the squadron, heads straight for the coffee pot, then sits down for the morning briefing by the operations officer. Being an "old head" crew, we were honored with two crew substitutions. A new navigator and EWO just out of Castle were scheduled to get their orientation ride with us. In addition, the pilot was to get a practice right seat ride to help prepare for an upcoming CFIC slot. The airplane we were scheduled to fly was recently assigned to the wing but no one could find its maintenance history. This riled the radar a little bit since he likes to research any system malfunction trends.

The mission itself was a typical profile we've flown before. After the usual length of time for paperwork completion, we started into the crew briefing. The pilot started his takeoff briefing with the usual detail and confidence. "As we start rolling and prior to S1, if anyone sees a need to abort, let the pilots know and we'll make that decision. If we do abort, I'll bring the throttles to idle, IP, you get the airbrakes to six, I'll deploy the drag chute above 70 kts and apply the brakes. Once we stop, if we need to abandon the aircraft, we'll meet off the nose of the aircraft. After the expiration of S1 timing . . ." It was the same briefing we heard the last time we briefed, and the time before that. It was nothing new, we've briefed it a hundred times, practiced the procedures in the simulator and also during ground egress training. Just a typical mission.

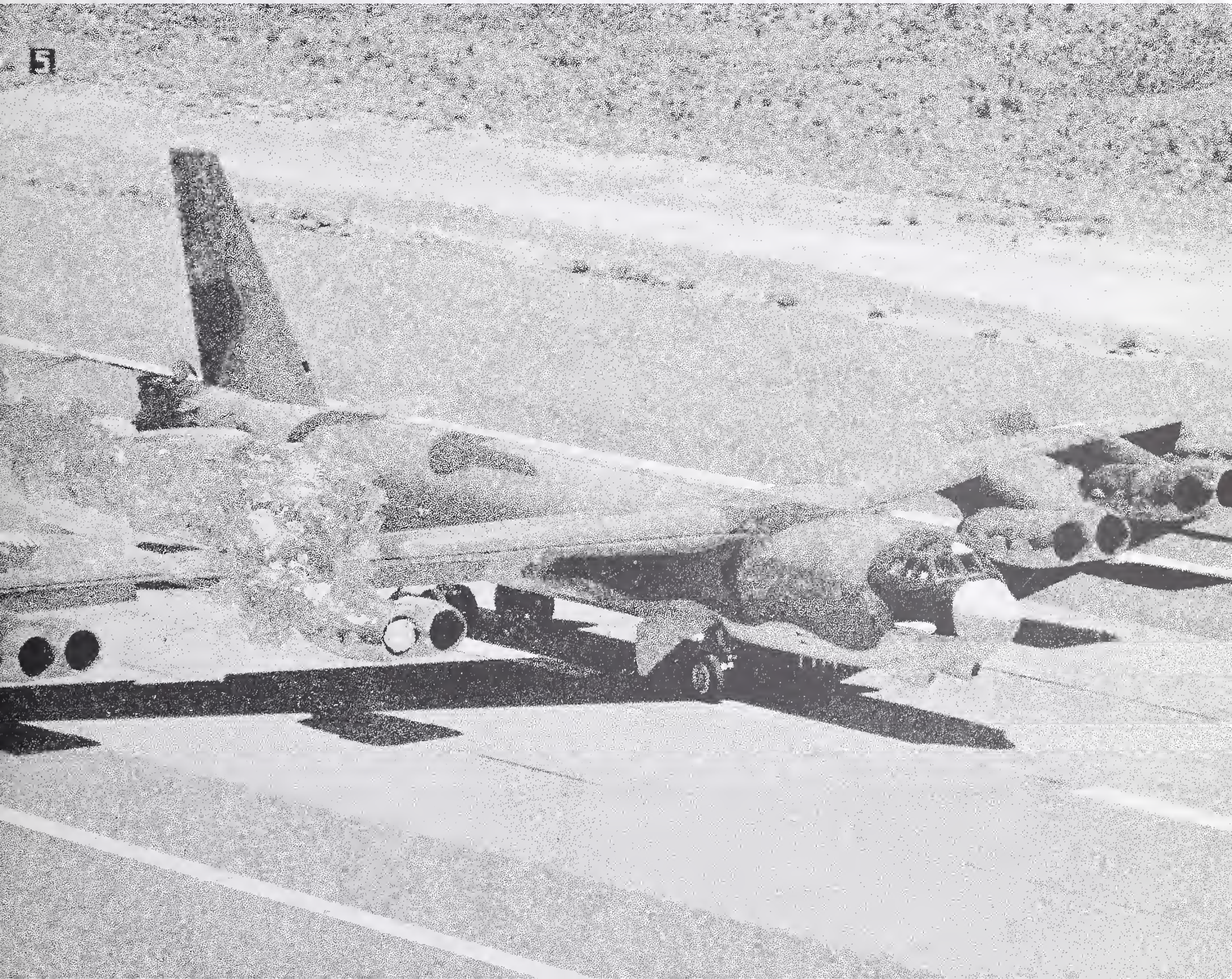
After a not-so-good night's sleep (you know those early morning showtimes), we found ourselves at base operations getting a weather brief. The ceiling was fluctuating around 500 ft. The runway visual range (RVR) was also fluctuating between 1000 ft. and 2600 ft. It was projected to improve, however, by takeoff time. The airplane was in no better shape. Maintenance all through the night had hampered the crew chief's efforts to prepare the plane for the aircrew. When we arrived they were still struggling to complete their preflight and the exceptional release had to be signed off. After a thorough preflight, the engine start and taxi occurred without delay. As predicted, the weather improved and the mission was a goer. Holding at the hammerhead for our IFR release, we completed the Before Lineup Checklist and the takeoff and abort procedures were once again briefed. After receiving the takeoff clearance from tower, each crew station did a last minute check. The radar looked over the new navigator and the defensive instructor (DI) and gunner doublechecked the EWO. At the 70 kts announcement, the navigator started his watch for the acceleration check. The radar also hacked a watch to back the navigator up. It seemed like another routine takeoff.

Just as the navigator keyed his microphone to announce the expiration of S1 timing, both pilots noticed a steady red light glowing above the engine instruments. The number six engine fire warning light had illuminated! The copilot announced, "Crew, we're aborting!" and pulled the throttles back to idle. The remaining abort steps soon followed in rapid succession. As the aircraft was slowing, the "old head" crewmembers started preparing for the expected aircraft evacuation: installing ejection seat safety pins, disconnecting parachutes, and unsnapping the oxygen hose connector. Our safety belts were securely connected.

For the new crewmembers these preparations were not so automatic. The radar found the new navigator staring at the EVS monitor. After some brief prodding, he soon followed the radar's lead. The new EWO had installed his pins but forgot to disconnect his parachute straps. As the aircraft came to a stop on the runway, the abandon command was given. A prepared instructor navigator (IN) quickly opened the crew entry hatch and the crew began an orderly exit. Several guys were so fast that they were out on the ground before the pilots could finish their checklist and exit their seats. The lower portion of number six engine was completely engulfed in flames and still burning during the evacuation. Expecting a headcount, several crewmembers stopped only one hundred feet in front of the aircraft. The raging fire quickly persuaded them to move further away. The crew finally gathered together a good 300 yards from the airplane for a head count and to make sure everyone was okay. At that time one could just make out the fire trucks approaching through the fog.

After taking a moment to collect our wits, we began to assess our actions during the abort. The regular copilot, sitting in the IP seat for the takeoff, did not have his flying gloves on. During the abort he pulled open the Dash One to help back up the pilots and had taken off his gloves to leaf through the pages. When the abandon signal was given he forgot to put them back on. The new EWO did not have his helmet on. He stated that when he heard the abandon command, he couldn't remember if he disconnected the oxygen hose, so he took the helmet off thinking that was the best thing to do. The "old head" pilot (remember, he was in the copilot's seat) commented that for a second he had to think about how to deploy the drag chute. "It had been quite a few years since I last deployed a chute from the right seat," he said.

The abort had been successful; the airplane and crew were safe. Everyone felt good about their actions and were glad these minor glitches had not caused any injury. Later on the crew had a chance to talk, joke and think about the whole incident. Everyone agreed: flying safety is not luck being on your side, it is something that is learned. It requires discipline and professionalism. Don't let that all-important awareness slip away because you've heard that briefing . . . a hundred times before.



SAC Tactics School
Nellis AFB

# Radar Site Coverage (Part II)

## Diagrams

In last month's issue of Combat Crew we introduced the methodology of low altitude radar site coverage analysis. Radar site coverage diagrams are graphic representations of the target detecting and tracking capabilities of a radar sited at a specific location. A completed coverage diagram shows the altitude and range at which targets become visible to a radar considering terrain masking atmospheric refraction and earth curvature. Figure I illustrates a completed coverage diagram applied to a segment of a hypothetical mission chart.

This article presents a detailed method for preparing low altitude radar site coverage diagrams for selected TA altitudes (200, 500, and 1000 ft AGL). In brief, the coverage analysis process consists of three principle parts:

I. Topographic Analysis (preparation of Chart Profile Lines)
II. Earth Curvature Diagram Preparation
III. Radar Site Coverage Template Preparation

In Part I, we detailed the tools needed and method for preparing chart profile lines during the topographic analysis process. In this article, we will discuss preparation of earth curvature diagrams and the completion of a finished radar site coverage diagram template.

Figure II shows a completed chart profile line drawn above a sample chart section. Recall from Part I that a chart profile line is normally prepared for every 10 degrees for the full 360 degrees around the site. Having completed the chart profile lines (Steps 1, 2, and 3 in Part I of this article) we are now ready to prepare earth curvature diagrams.

**Figure II**

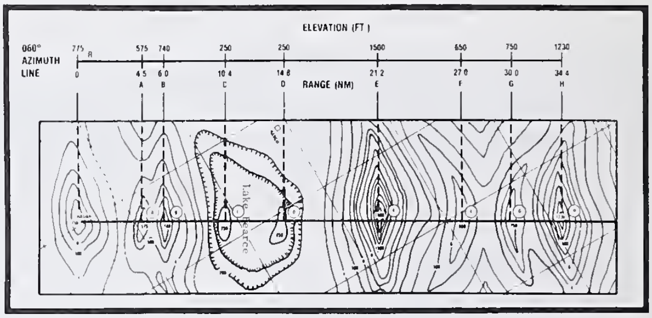
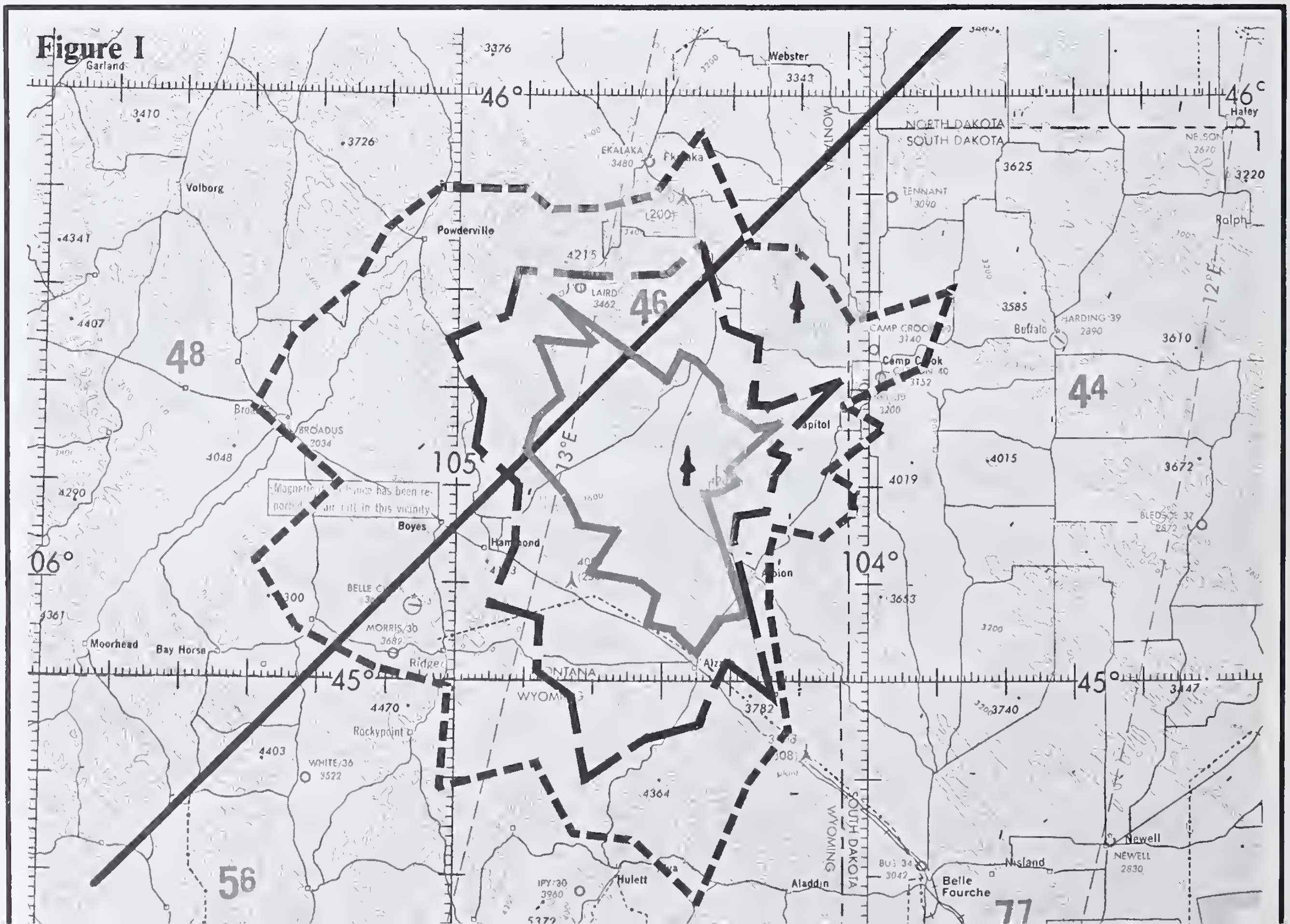
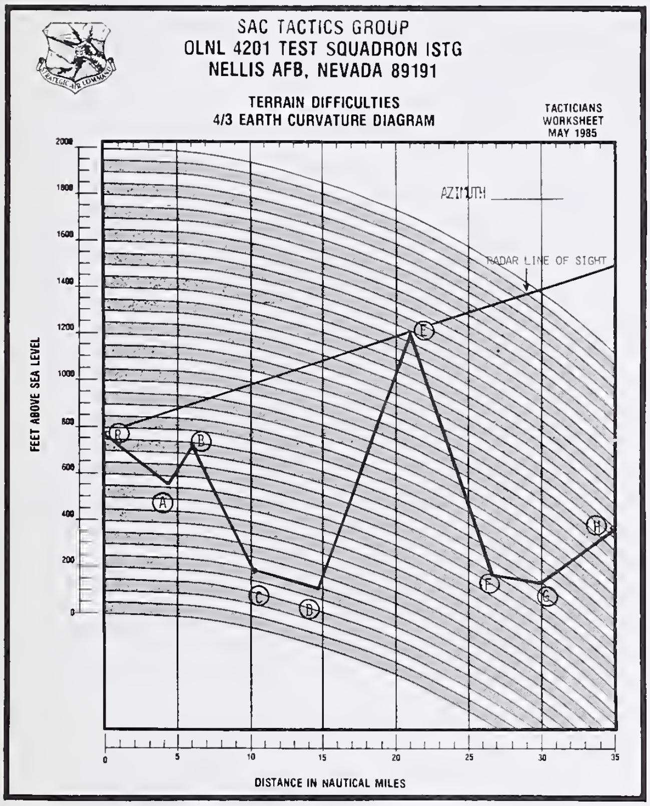


**Figure I**



**Step 4:** Prepare an Earth Curvature Diagram for each chart profile line. Figure III shows the sample chart profile line plotted on the curvature worksheet. This is done as follows:

**Figure III**



a. Decide which scales to use on the curvature worksheet (large or small). The important thing to remember here is not to "mix" the scales; i.e., for each worksheet, use only small scale with small scale or large scale with large scale. If it is necessary to plot altitudes above 2000 feet or ranges over 35 NM use the large scale numbers. If not, the small scale is used. Mark through the unused scale numbers with a dash. **Label each curvature worksheet with the azimuth of its corresponding chart profile line.** A curvature worksheet must be prepared for each chart profile line.

b. Plot the radar on the curvature worksheet by placing it at the left side (range zero) and at the determined altitude above sea level (in this case, 775 feet MSL). Label this point "R" for radar.

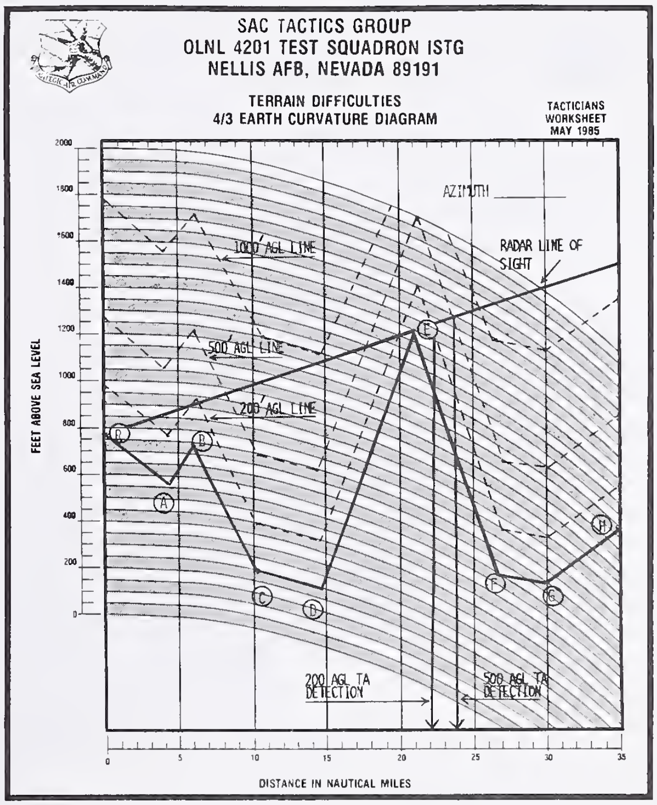
c. Plot the position of each prominent terrain feature recorded on the chart profile line at its appropriate range and altitude from the radar ("R"). Be sure to label each feature with a letter corresponding to the profile line features.

d. Using a straight edge, connect the dots in sequence. Now, using the "R" as a pivot point, rotate the straight edge clockwise until you cross the first terrain feature and extend it to the right-hand margin. This line represents the radar's **actual line of sight.**

e. Now construct **TA Detection Lines** as shown in Figure IV. Altitudes of 200, 500, and 1000 ft AGL are used in this step.

- For the 200 ft TA detection line, mark a dot 200 feet above each terrain point on the curvature worksheet. Connect these dots with a dashed line as shown. From this dashed line you are now able to determine the **target acquisition point** of the radar site by noting the point at which the radar's line of sight intersects with the TA detection line. In this case, the radar would first detect a 200 ft AGL target at a distance of 22 NM.
- Repeat the construction of TA detection lines for each altitude desired (usually 200, 500, and 1000 ft AGL) and determine the maximum detection range.

**Figure IV**



f. The last procedure you must perform is to identify **radar dead zones.** These are close range volumes of airspace masked from the radar's view by terrain features. These are analyzed as follows:

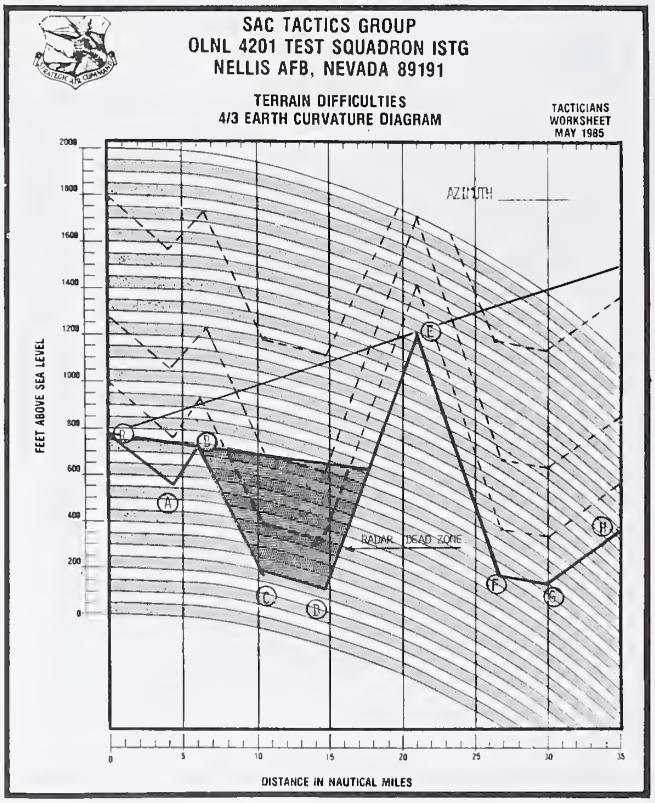
- In Figure IV, an aircraft flying at 200 ft AGL is hidden from the radar's view by feature "E" at ranges beyond 22 NM, or beyond TA detection range.
- Using "R" as a pivot point, pivot the straight edge until it again intersects a terrain feature (point "B"). Draw a line from "R" to point "B" and extend it as shown in Figure V to the right side of the worksheet. Airspace beneath this plot represents **close range radar dead zones.**
- Repeat this procedure for all other prominent ter-

# Radar Site Coverage (Part II)

rain features on the worksheet and shade in the identified dead zones.

- Read the ranges (from the bottom scale) at which a target will be lost, then reacquired. In Figure V, the target will be initially detected at 22 NM as it clears point "E" and remain visible until it enters the dead zone at 18 NM. It will not be visible again until it reemerges at 7.5 NM.

Figure V



SAC TACTICS GROUP
OLNL 4201 TEST SQUADRON ISTG
NELLIS AFB, NEVADA 89191

TERRAIN DIFFICULTIES
4/3 EARTH CURVATURE DIAGRAM

TACTICIANS
WORKSHEET
MAY 1985

AZIMUTH

g. Repeat this entire process for each of the earth curvature worksheets (representing each of the azimuth's plotted).

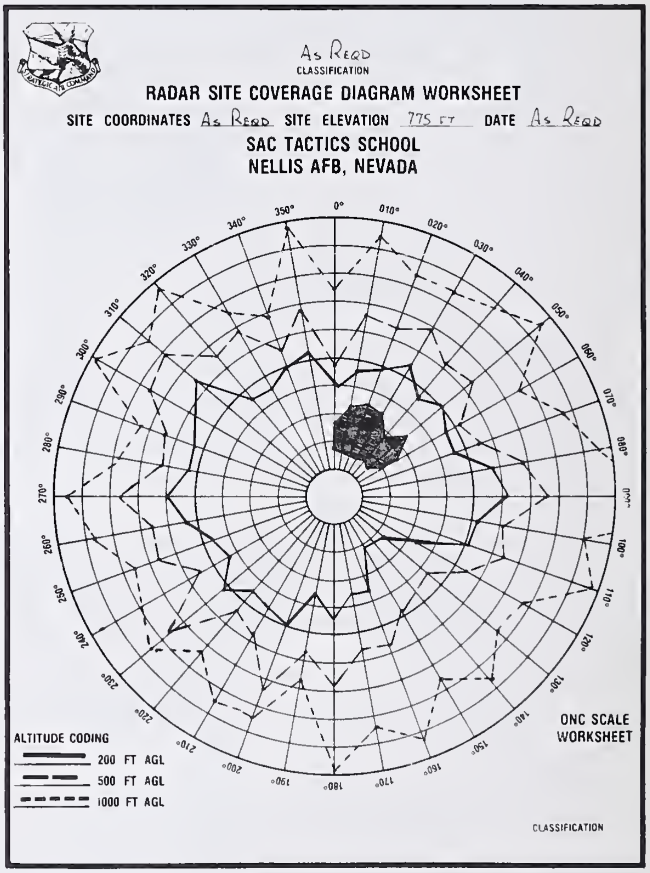
**Step 5:** At last! We're almost done. We may now construct the radar site coverage diagram, using templates for either ONC or TPC charts. Obtain the proper scale template, fill in the heading, and select a method of distinguishing different coverage altitudes on the diagram. For instance, plot 200 ft AGL in red, 500 ft AGL in blue, and 1000 ft AGL in black:

- Beginning with 000 degrees, transfer the information from each 4/3 earth curvature worksheet to the template. Start with the 200 ft AGL TA detection line, read the initial detection range and plot if on the appropriate azimuth line. Repeat this process for all altitudes on the curvature worksheet. Be sure to plot radar dead zones as well.

- Sequentially connect all of the points plotted. The resulting template now shows the TA detection points for a 200 ft AGL aircraft at all azimuths from the radar site.

- Repeat this process for all altitudes and radar dead zones. The final result will look like Figure VI.

Figure VI



As Reqd
CLASSIFICATION

RADAR SITE COVERAGE DIAGRAM WORKSHEET

SITE COORDINATES As Reqd SITE ELEVATION 775 FT DATE As Reqd

SAC TACTICS SCHOOL
NELLIS AFB, NEVADA

ONC SCALE
WORKSHEET

ALTITUDE CODING
200 FT AGL
500 FT AGL
1000 FT AGL

CLASSIFICATION

**Congratulations!** You now have an exact representation of this site's radar coverage at selected TA altitudes. You may overlay this on to your mission chart and determine exactly the correct altitude necessary to defeat this threat. Good luck and good flying!

THE CUTTING EDGE

# The Training Doctor . . . for ICBM Crewmembers Only

Capt Jimmy C. Crook
Capt Val J. Evans
Vandenberg AFB

"Train the Trainers" is the motto of a select section within the 4315th Combat Crew Training Squadron (CCTS). In this brief narrative, we will inform and remind the missile community who we are, what we do, and how you can get us to do it for you.

First, who are we? The section comprises five missile staff officers and one education and training officer. The missile officers are chosen from our selectively manned squadron instructor cadre. You might say we are the best of the best instructors — at least, that's what we like to say.

Second, what do we do? Our section teaches and advises trainers within our squadron and throughout the command. We accomplish this through a wide array of courses. Within the squadron, we teach three courses designed to aid our faculty members. The Instructor Orientation Course prepares new instructors to assume their duties within the squadron. It consists of an orientation to the squadron organizational structure, Missile Procedures Trainer Operator training and many other briefings and events that lead to initial instructor certification. The Missile Academic Instructor Course is our in-house course, used to qualify our academic instructors. In this course, we teach the principles of lesson planning, instructional theory, the use of training aids in the classroom, and other pertinent details for making the best possible classroom presentations. We also teach a Recurring Instructor Training block to all sections approximately once a month. In this class we review old and present new concepts in the training business.

For the command, we teach three other courses and are the point of contact for two more. We teach Robert F. Mager's Criterion-referenced Instruction Course, a commercially procured course used to teach Instructional Systems Development procedures. The Missile Instructor Course deals with the same type of curriculum as the Academic Instructor Course, but is geared to the weapon system instructors at the wing level. It's a three day course and we teach it twice a year at each missile wing. The Wing Instructional Systems Managers' Course prepares staff officers for duty as education advisors at the wing level. We coordinate the two Missile Staff Officer courses by acting as a point of contact between the weapon system sections here, the wings sending staff/command officers, and HQ SAC/DPATF (who schedules all our command courses).

Finally, we work special projects for the HQ SAC Directorate of Missile Management. One of the special projects we have currently underway is an analysis of what and how we teach future Minuteman crewmembers in our Initial Qualification Training program. We started with the Minuteman II/Command Data Buffer weapon system. To accomplish this major undertaking, we have asked for help from the 321st and 341st Strategic Missile Wings, the 3901st Strategic Missile Evaluation Squadron, our own Courseware Development Section, and from HQ SAC/DOM.

Initially, we divided the work required to do the analysis into parts, and set up conferences to do each part. The conferences are composed of weapon system experts from the field, evaluators from the 3901st, HQ SAC/DOM and our 4315th representatives.

For the first conference we outlined our purpose for the task analysis, i.e., to define and document the job, duties, tasks, subtasks, skills, and knowledge required to be an alert qualified crewmember in the Minuteman II/Command Data Buffer weapon system.

Next, using shorthand pyramids, we grouped and outlined all alert duties. Here we emphasized identification, location, and function of the equipment involved.

In the second conference, we used the shorthand pyramids developed in the first conference to identify all the tasks, subtasks, skills and knowledge involved in normal missile operations.

The next conference, scheduled in July, will define all tasks, subtasks, skills, and knowledge involved with normal and emergency procedures. We will then assign proficiency level codes to all tasks, and write the Job Performance Requirements Listing.

Third, and finally, how do you get us to do it for you? To attend any of the courses we teach, contact the Classification and Training section of your local CBPO. They will arrange for quotas in the desired class. If you'd like us to present the Missile Instructor Course to your organization, provide a rapid response to the scheduling letter we send out each summer for the next year's classes. And finally, we do offer free advice on training related questions or problems. Just call and ask for one of our Training Science Instructors at Autovon 276-9944.

Well, there you have it. If you need more information or need the Training Doctor to make a "house call," just give us a call or write to 4315 CCTS/CMMS, Vandenberg AFB CA 93437-5000.

CROSSCHECK SIFC

# BE RIGHT, NOT DEAD RIGHT

SIFC Staff, Castle AFB

This month's article is dedicated to three specific questions on approach procedures and design because of the concern and interest they've generated. The questions are simple, but the answers require some thought.

**QUESTION:** "My copilot was flying a PAR approach the other day and brought up a good question. Just before the decision height (DH) was reached on the altimeters the PAR controller called us at decision height. My copilot continued to descend another 50 feet, which brought us to the decision height on the altimeters, and then began the missed approach. This began a discussion on what should be used for the DH, the altimeters or the PAR controller's call?"

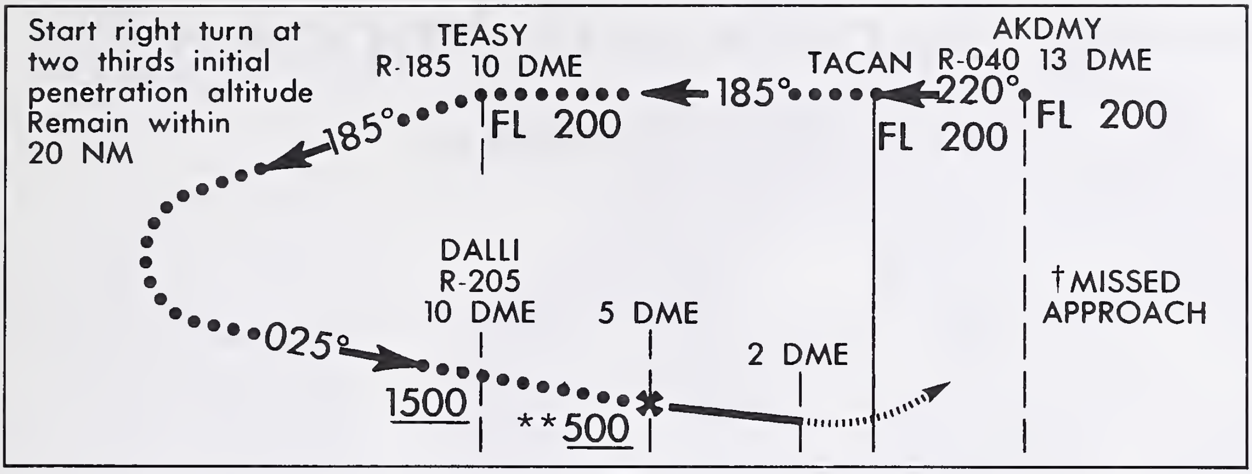
**ANSWER:** The missed approach decision must be made at the DH as called by the controller or the DH indicated on the altimeter, whichever occurs first. This is spelled out in AFM 51-37, para 6-17e(2)(f). The reasons for this procedure are obvious:

- We accept up to a 75-foot pressure altimeter error as within usable tolerance.
- Although unlikely, a controller can unintentionally omit the DH warning.

Ideally, the controller's DH warning and the altimeter DH indication should coincide. However, because of the many variables present, differences in the two DH indications are not infrequent. Individual controller interpretation of the radar blip position and altimeter inaccuracies will cause DH indication differences. The requirement to abide by the first DH indication to occur is, therefore, the only policy. This is particularly true when flying a PAR approach to a DH providing a 100-foot height above touchdown (HAT) because with a 75 foot altimeter inaccuracy you could be within 25 feet of the ground. Keep in mind that the controller will call the DH at the "published" DH. Since SAC requires PAR decision heights to provide a minimum of 200 feet HAT, we normally reach an adjusted decision height on the altimeter well before the controller calls the published DH. Because of this we need to be watchful when we fly PARs with published DHs providing 200-foot HATs or higher.

**QUESTION:** "I've just been chastised by my training flight IP for not complying with a recommended altitude published on an approach. When an altitude is depicted without a line above or below it, can't you decide what altitude you really want to be at as long as you know it's safe and you won't hit anything?"

**ANSWER:** The above profile view of an instrument approach is a typical combination of a recommended altitude and a fly-off. We will use this example in our discussion of recommended altitudes. This instrument approach was the subject of a misunderstanding between the FAA, the approach designer, military approach controllers and aircrews. The two points of confusion were the significance of a recommended al-



titude (FL 200) and the implication of a level penetration fly-off (to the R-185/10 DME). Let's review how these different groups thought the procedure worked.

The FAA required a level fly-off be designed into the approach because of a low altitude airway passing under the fly-off segment of the approach.

The approach designer did not make FL 200 a minimum or mandatory altitude because approach control wanted to have the flexibility of using altitudes other than FL 200 when there was no traffic along the low altitude airway beneath the penetration fly-off.

The approach controllers thought they could hold an aircraft at any reasonable altitude, clear the pilot for the approach, and the pilot would maintain that altitude until reaching the R-185/10 DME.

Because FL 200 is only a recommended altitude, some pilots thought they could descend to the next minimum altitude restriction (1500 feet) any time they desired after departing the IAF (R-040/13 DME).

Now, with these different viewpoints in mind, you can see the potential for a mid-air collision. The controller is holding an aircraft at FL 200 and clears the pilot for the approach. The pilot departs the IAF and decides to perform a gradual descent to 1500 feet rather than remaining at FL 200 until R-185/10 DME and then initiating a steeper descent. Now add to this scenario another aircraft flying along the airway and you have all the ingredients of a mid-air collision.

After this hypothetical mishap, the approach controller would likely say the pilot should have maintained level flight from the IAF to the R-185/10 DME because anyone can see the dotted line in the profile view is depicted as a horizontal line. If the pilot was still alive he would probably say, "I didn't have to remain at FL 200 after departing the IAF because FL 200 is only a recommended altitude.

Who is right? The simplest solution to this problem is to make FL 200 a minimum or mandatory altitude restriction at both the IAF and the R-185/10 DME fix. However, this wouldn't solve the problem of using recommended altitudes in other instrument approaches. ATC needs to have this flexibility in areas of dense air traffic.

Okay, so how should recommended altitudes be flown? We suggest that a pilot comply with the recommended altitudes depicted on the approach chart, and if you desire to deviate, advise the controller. You may be right in deviating without a clearance, but then you may be DEAD RIGHT?

**QUESTION:** "If you have an approach similar to the one above, how can you get it changed? We've had numerous inquiries about who is responsible for designing and approving the instrument approach procedures at the unit level."

**ANSWER:** AFR 60-27 states that each wing or base commander is responsible for requesting publication of the minimum number of instrument approach procedures. SACR 55-3 provides the senior operational commander the responsibility to establish a base air traffic control (ATC) board. Through this board, IFR terminal procedures will be locally developed and expanded. Some of the required board actions involving instrument approaches are:

1. Request only the minimum procedures essential for the mission.
2. Conduct a flyability check of instrument procedures.
3. Annually review, revalidate and advise AFCC of the requirement for all terminal instrument procedures.
4. Coordinate on all procedures at airfields under its jurisdiction.
5. Submit the request for waivers when required.

But how do you get involved in this process? If you are not a member of the ATC board you can talk to your local TERPs expert. Being graduates from TERPs school, they are responsible for the drawing and development of the instrument approach procedures at your unit. They are usually assigned to either RAPCON or the tower and work TERPs as an additional duty. Not being pilots, they are receptive to any ideas or problems you are having with your instrument procedures. If you want to add or change a procedure they should be your first stop since they can provide you with the expertise needed to sell your ideas to your unit.

That's it for this month, if you have any instrument questions talk to your unit SIFC graduates. If you can't locate them, or they can't provide you with the answer, write or give us a call.

# Missile Standboard: Impetus for Excellence

1Lt David Petrillo
351 SMW/DOV
Whiteman AFB

"The evaluation program should promote combat crew mission capability and safe peacetime operations. These are achieved through objective evaluations with rapid feedback, and by providing standard procedures and performance criteria." SACR 50-6

A member of a strategic missile wing's Standardization Evaluation Division, a deputy commander, freshly assigned from one of the strategic missile squadrons and a chap known for his goodwill and easy demeanor, recently walked into the predeparture briefing room of his parent squadron for a friendly visit home.

While his reception was eventually warm and genuine (for any "crew bear" knows squadron bonds are not so easily severed), it was preceded by the stock line crew verbal abuse that is so often playfully directed at DOV. "Hide the cookies and milk, boys, DOV's here." "Please don't check my T.O. lieutenant, sir, (from a captain, of course). I left a grease pencil mark on page 5-47b and I can't bear to get another significant deficiency for it." Of course, being the good-natured fellow that he is, the deputy evaluator was prepared for the banter and purposely underscored his profession's reputation with a cut or two of his own. "Excuse me, captain? Uh, don't you have a trainer ride coming up soon, sir? I think we can arrange to give the instructor crew the day off there. See if we can't get you another one of those opportunities to excel. As a matter of fact, I think we've got a brand new evaluation script coming out with your name on it. Real piece of cake, though. Of course, I'd make sure my service dress uniform was nice and clean if I were you . . . just in case . . ." So it goes.

Although a somewhat playful example of the social relationship between the standboard shop and the line crew force, the above is a simple representative indicator of an underlying mild antagonism that is understandably a natural element in the relationship. Yet, antagonism, by definition, depicts a condition of opposing forces. While this may seem to be a natural part of the evaluator/evaluatee relationship, it is no more than a superficial perception felt by the participants and not the actual essence of the relationship. These are not antagonistic forces but supportive ones. Indeed, the unique role of the standboard evaluator places him in a position to be the impetus for excellence among the crew force, while at the same time being the crewmember's best assurance that his needs are considered and his burdens and responsibilities understood and appreciated.

**"Hide the cookies and milk, boys, DOV's here."**

Often, though, it is the new evaluator himself who doesn't realize the influence he may have on crewmembers performance. The first months in a standboard shop are spent first and foremost learning how to properly administer an evaluation and identify and assess the resulting errors. Additionally, a new evaluator must adjust to this influential position. The amiable fellow fresh from the line still wants to be one of the boys, yet his position as an evaluator precludes him from discussing his schedule too loosely or speaking too freely about certain scenarios or specific scripts. While it may not be a difficult adjustment to make, it can at times create some anxious situations. A brand new commander evaluator, for example, had to certify before his Senior Crew by giving a no-notice evaluation to his roommate. Imagine the anxiety created when an already nervous situation for this evaluator was intensified by his inability to speak freely about his work and training for fear of inadvertently tipping off his roommate. It is no wonder, then, that the new evaluator may not always realize the positive influence his position has on the crew force. Though he may initially see himself as joining the ranks of the wing's "bad guys," he is actually assuming a role that allows him to help contribute to the excellence and well-being of the crew force.

The evaluator must strive to make his shop a prime stimulus for crew force excellence. While the instructor shop bears the burden for the training of the crew force throughout the year (a task of comparable importance to any performed in DOV), the Standardization/Evaluation Division bears the final responsibility for identifying crew force deficiencies. Consistently identifying and documenting deficiencies throughout the year, reporting those deficiencies to the appropriate training agencies and, finally, ensuring the deficiencies are "trained out" with technically accurate training materials are primary objectives of the division. It is of vital importance that the evaluator determine not only that an error was committed, but why that error was committed. While it may simply indicate some individual weakness on the part of the crew or crewmember, it may also reflect something far more significant. Trends may appear revealing more general deficiencies throughout the crew force. The error may be the result of inadequate procedures or insufficient technical data. Perhaps the training materials must be reviewed or tech data changes submitted to improve or correct existing procedures. The evaluator must take his charge seriously and never leave uncorrected even small deviations from the prescribed command standard.

This is not to say that the evaluator need slap a minor error on the fellow who inadvertently uses his index finger on a thumbwheel switch. There are "weenies" and then there are "weenies." Still, the evaluator must remember that correcting an error, however small, is always a contribution toward excellence. It is not the identification of an error or deficiency that defines it as a so-called "weenie" but how the matter is handled. One cannot tell an evaluator the best way to handle any situation except to say that he needs to concern himself with "how" as much as the "what" of the situation. It is an art to be able to tell someone he is wrong in a manner which is constructive and supportive and without the slightest hint of degradation. Although there are as many techniques in this art form as there are critics of any kind, some such eloquence should guide an evaluator as he takes actions on a recognized deficiency.

Certainly it is no secret that crewmembers often are nervous when performing their duties in the presence of an evaluator. During a check, an observation, or normal crew changeover, it is natural for even the most confident crewmember to feel anxious knowing that his every action is being carefully observed. The burden here again rests with the evaluator to put the crewmember at ease. By the same token, the evaluation or observation must be conducted professionally. A crewmember should never be put so at ease as to feel he has the option to take a shortcut because the evaluator is lax. During crew changeover, an evaluator should be conscious of the tension his presence may cause in a line crew and do his best to alleviate that tension by making the changeover pleasant and matter-of-fact. Still, an evaluator must create an atmosphere wherein nothing less than the highest standard will be practiced at all times. This perhaps is the most subtle yet crucial part of the evaluator's job and the one most difficult to master.

In short, the evaluator should show confidence in the evaluatee and present an image that seems to say, "I know you know your job. Relax and do it."

This type of professionalism will be reflected in the wing report card, the annual 3901st Strategic Missile Evaluation Squadron (SMES) evaluation. When the crew force is confident because they've performed well all year to the high standards of their own DOV, they will be confident in front of the SMES. When crews handle themselves in a self-assured, professional manner during a SMES evaluation it is because the unit Standardization/Evaluation Division, the impetus for excellence, has called for and exemplified that behavior all year long.

Aside from strictly evaluating, though, the evaluator should remember that, along with the members of the instructor shop, he is in a unique position to provide the crewmember some assurance that his needs are considered in the establishment of crew procedures. Unit standardization and training divisions are the only agencies whose members actually perform alert duties and provide input toward crew procedures. Individuals actually performing alert duties are in an excellent position to judge the efficiency of crew procedures and accuracy of associated tech data checklists. When procedures are developed or reevaluated, the input crewmembers provide from their field experiences make an important contribution. Similarly, crewmembers best understand the pressures and associated responsibilities of crew duty, and the effect those pressures have on their job performance. Therefore, an evaluator is constantly responsible to the crew force to see that their needs are a consideration when procedures are fine-tuned to facilitate the successful accomplishment of the mission.

If nothing else, our good-natured friend, the former line crewmember, now a deputy evaluator, should remember each and every day that he is a missile combat crewmember first and foremost. As a line crewmember he expected to be treated with dignity by evaluators and was the benefactor when that treatment was constructive and supportive, as it should be. Now, as an evaluator himself, he has the opportunity to provide that service for the benefit of others.

# PROFESSIONAL PERFORMERS

## Aircraft Maintenance

TSgt Ronald L. Jones, 42 FMS, Loring AFB, is SAC's Maintenance Airman of the Month. As a supervisor in the electric shop of the aerospace systems branch, Sgt Jones developed an approved modification to the KC-135 external power receptacle cover and wire rerouting. Sgt Jones produced and improved methods of replacing the receptacle terminals without rewiring this system. This highly successful method was used on several aircraft and resulted in a 90% man-hour and 75% material savings.

When the 42 BMW recently was assigned new offensive avionics system (OAS) aircraft, Sgt Jones was tasked with an excessive backlog in the NI-CAD battery shop. He developed a revised maintenance operating instruction for battery charge out on assigned aircraft. He then directed a complete renovation of the battery shop to add extra battery chargers with an overall improvement to the shop area and design. The revision and renovations greatly reduced the NI-CAD battery shop backlog.

## Missile Maintenance

SSgt Debra G. Tilly, 394 ICBM Test Maintenance Squadron, Vandenberg AFB, is SAC ICBM Maintenance Airman of the Month. As refurbishment crew chief, she played a vital role while contributing to four launches in support of the MINUTEMAN follow-on operational test and evaluation program. Through her demonstrated maintenance expertise, Sgt Tilly was instrumental in the Refurbishment Section receiving its seventh consecutive "Excellent" rating from 3901 SMES. Additionally, Sgt Tilly has received two "Highly Qualified" certificates and was awarded "Qualified" and "Highly Qualified" ratings from 3901 SMES. Sgt Tilly has also excelled academically. She was the first person to complete the 80-hour special purpose vehicle operators course and scored 100% on the written test and road evaluation. She graduated from the SAC Noncommissioned Officers Leadership School in March 1985 and earned the Academic Achievement Award and the Honor Graduate Award. Sgt Tilly is a highly motivated NCO who is totally committed. She is a valuable asset to the SAC ICBM maintenance effort and the Air Force.

## Munitions Maintenance

TSgt Stephan M. Hand, 416 BMW, Griffiss AFB, is SAC's Munitions Maintenance Airman of the Month. Assigned to the weapons release section as the night shift supervisor and dispatcher, Sgt Hand coordinates and directs personnel and equipment in support of the offensive avionics system on the B-52G aircraft. During a recent ORI and MSET visit, Sgt Hand's aggressive leadership directly resulted in excellent ratings for the munitions services branch. As a member of the "Tiger Team" tasked with troubleshooting aircraft 58-0176, he demonstrated superior technical ability and resourcefulness. This aircraft had developed problems dropping BDU-38s during Red Flag missions. After many long hours of concentrated maintenance, the team found — and replaced several malfunctioning relays that were failing to make proper contact. The aircraft has since flown several missions without any discrepancies, and is now fully mission capable. Sgt Hand also supervised the first time compliance technical order No. 1B52G-796, Inspection of Rotor Shims. He removed the rotor, made many critical measurements between the rotor and the pressure plate, and added the proper amount of shims to make the loading and unloading of pylons more efficient.

## Missile Crew

Crew R-181, consisting of Capt William E. Molter, MCCC and Capt Walter M. Hooker, DMCCC, 341 SMW, Malmstrom AFB, is SAC's Missile Crew of the Month.

Crew R-181 was in the middle of crew changeover and had just completed the launch control equipment building inspection when they were faced with total darkness and a total loss of power. The crew exited the equipment building and entered the LCC when all troubleshooting steps in the tech order had failed. They continued changeover with the old crew by the faint lights of their emergency lighting system. The flight security controller (FSC) notified the crew that there was a maintenance team requesting entry onto their site and into their LCC to bring it back onto commercial power. After indepth troubleshooting by the maintenance team in the LCC, a series of fuses were found to be blown. The team had just restored commercial power when another problem caused the LCC to drop back onto battery power. The team was able to bring the LCC back up on standby diesel power while they did a total system checkout. Shortly after this, the MCCC was in the rear of the LCC when he heard a loud bang and heard the motor-generator winding down. A second loud bang was heard and the LCC was thrown into total darkness. When the crew approached the rear of the LCC, they suddenly noticed a strong smell of burning wires and a cloudy haze developing within the LCC. After opening the blast door, the crew proceeded immediately to isolate the overheat condition and fight the fire. The crew discovered smoke coming from the motor-generator and shut down all power to the LCC. The quick actions by the crew and coolness under fire prevented injury and further equipment damage.

---

## Flying Crew

Crew E-124, 349 AREFS, Beale AFB, departed Kadena AB recently on a HHD mission. The crew, commanded by Capt LeeRoy A. Martin, consisted of: 1Lt Eric A. Bowen, copilot; 1Lt Michael L. King, navigator; SrA Richard M. Evans, boom operator, and 2Lt Joseph E. Simons, additional copilot. Climbing through 1500 feet at water injection runout, the navigator saw abnormal EPR fluctuations on engine number four and pointed them out to the pilots. At that same moment, number four began to backfire, and the copilot reported flames coming from that engine. By reducing thrust, the crew was able to control the explosions. A visual inspection revealed oil leaking from the engine nacelle. Shortly thereafter, loss of oil pressure required shutting down the engine. At the direction of the pilot, the boom operator and copilot began emergency fuel dump procedures. Capt Martin and Lt King coordinated the emergency with NAHA control and command post. Lt Simons assisted in reviewing dash-one procedures for landing with an engine out and figured the landing data. The aircraft gross weight was adjusted from 265,000 to 140,000 pounds and a successful three engine approach and landing was made on Kadena's runway 23R. Subsequent investigation showed that at water runout, a third stage, N-1 compressor blade had sheared, penetrating the compressor case and cutting an oil feed line. Oil pooling in the hot section of the engine was ignited and the turbulent airflow from the unequal blade distribution combined to cause compressor stalls and backfiring. The decisive actions and superb crew coordination prevented further damage and allowed a safe, professional recovery.

# SAFETY CROSS FEED

## GROUND SAFETY

### Certain Death

A SAC NCO suffered fatal injuries when he elected to operate his motorcycle while under the influence of both alcohol (.09) and depression (due to domestic problems). That led to excessive speed. He struck a retaining wall, was ejected from the bike and landed 188 feet below the highway on which he was traveling.

### Brief Thrill

Another motorcyclist decided to "burn rubber" from a standing start at a traffic light. When he released the clutch, the front wheel came up abruptly throwing the rider off the cycle which then fell onto his leg. He lost 10 days work as the result.

### Who Needs 'Em?

An airman using a tanning booth elected not to wear the dark lens goggles provided. He also failed to keep his eyes closed and suffered burns to the cornea of both eyes.

### Strange Encounter

Driving his compact car in a parking lot, a tech sergeant was startled by a modified pickup with raised suspension and oversized tires headed directly toward him. He swerved violently to avoid a perceived collision and struck a cement abutment light pole. The alcohol in his blood probably made matters look worse than they were.

### Man's Best Friend?

A master sergeant working in his basement tripped over the family dog. As he fell, he knocked an aerosol can from a shelf, which struck his right ear and punctured the eardrum.

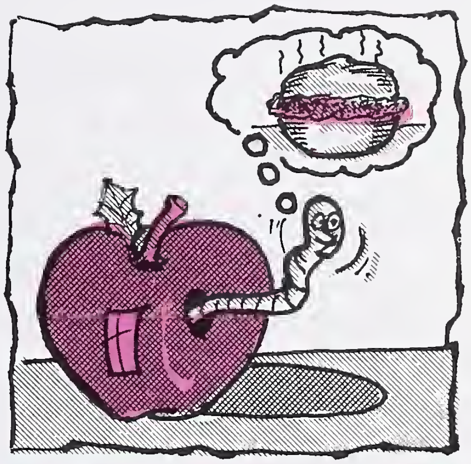
### Use the Right Equipment

A piece of heavy gauge sheetmetal, supported by makeshift means fell and severely bruised a worker's foot. The proper support for the sheetmetal was within arm's reach.

# FLYING SAFETY

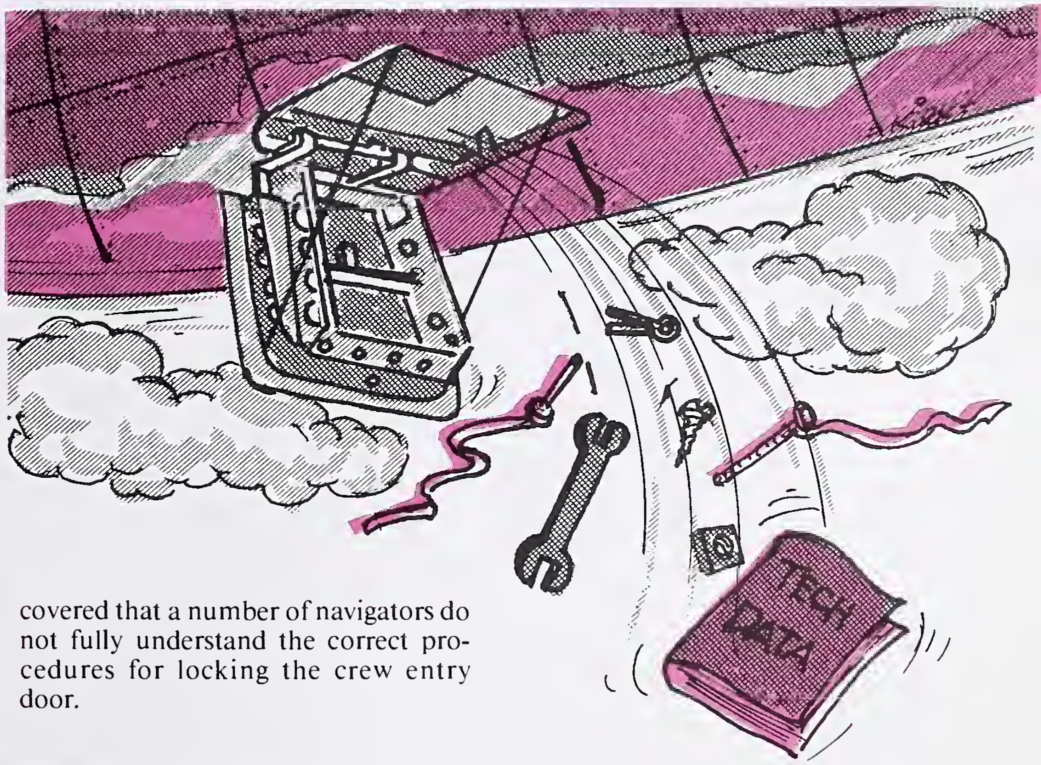
## Food for Thought

We all know crewmembers are gourmets while on cross country trips. Recently two crewmembers (the entire crew) stopped in at a concession for a combo sandwich prior to continuing on the last leg home. The navigator ate his sandwich almost immediately while the pilot ate his 1 + 40 after takeoff. Within an hour, the pilot was acutely ill with rapid onset of nausea and vomiting. After approximately 20 minutes, he felt reasonably well. The navigator had his attack of nausea and vomiting during landing roll. This could have been a different story if both crewmembers had been sick at the same time. To eliminate this problem, airline pilots that are crewed together are required to eat different kinds of foods. The next time your crew eats the same food, think about the possible consequences if the meal happens to be tainted.



## "Bombs Away? Nav? Nav?"

The mission started normally for our young bombardier. An electrician was called out during preflight because the hatch light would not go out when the main entry door was closed and locked. The entry door was closed and locked after engine start, but opened again for red ball maintenance on an unrelated problem. The door was closed and the light checked "out" when maintenance was complete. On climbout passing FL 200 the main entry door popped open, causing the loss of six ground locks, six filler panels and two bypass keys which were stored in the hatch under the grate. The technician had erroneously adjusted the hatch warning light switch so that the light would go out without actually having the hatch locking mechanism fully engaged. It was subsequently discovered that a number of navigators do not fully understand the correct procedures for locking the crew entry door.



# WEAPONS SAFETY

## Damaging Diode

The installation of a diode during a recent modification of the MAU-12 rack has resulted in a serious test problem. When power is applied, a reverse polarity condition causes damage to the missile interface unit. All modified MAU-12 injector racks are to be demodified. Warner Robins ALC is investigating this problem and will provide a solution shortly.

## Turn It Off

A Minuteman III digital data power supply was damaged during preparation for a missile emplacement when technicians failed to remove power prior to installing a shorting cap on the lower umbilical.

## Not Too Cool

A Minuteman II missile guidance section was damaged during start-up because of a lack of coolant. The coolant loss was caused by an improperly connected right surge attenuator line.

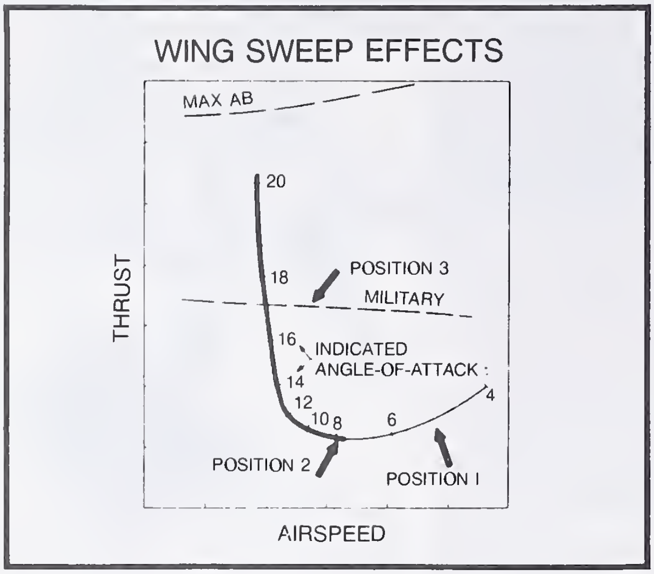
*Cont'd from page 7*

the aircraft to approximately 10 degrees AOA where command augmentation would attempt to maintain one G flight. To achieve the desired 2-5 degrees AOA and accelerate recovery, command augmentation must be overridden with positive forward stick. Wings must be swept forward and recovery controls held until AOA is well below stall and decreasing and airspeed is increasing; then recover to level flight. When leveling the aircraft, it must be stressed that by pulling positive G's, it is possible to stall again. The AOA indicator is the primary instrument in a stall recovery to insure limits aren't exceeded. To demonstrate an accelerated stall, roll into a turn well below stall AOA increasing G loading until stall warning occurs (see chart 5). By reducing the "G" commanded, the stall condition is broken immediately and the aircraft can be rolled wings level and recovered.

### Wing Sweep Effects

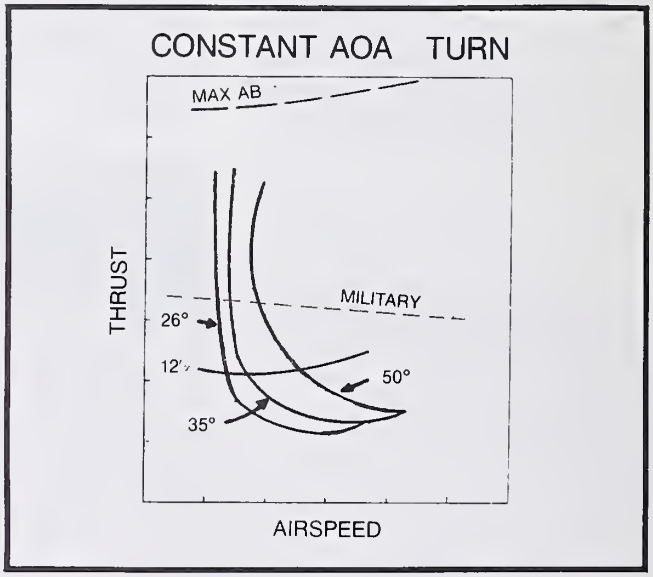
The wing sweep effects demonstration incorporates almost all the unique aerodynamic effects of the variable geometry aircraft.

**(FIGURE 7)**



The maneuver begins at an airspeed of 340 kts and level flight with the wings at 26 degrees and approximately 5 degrees AOA. At this speed and wingsweep, the aircraft is well ahead of the power curve (position 1). Rolling into a turn at this speed shows a small change in AOA and a crisp roll rate with spoiler assistance. Maintaining a steady 340 knots and sweeping the wings aft to 54 degrees moves the aircraft toward the back side of the power curve (position 2). To maintain level flight, AOA is now around 8 degrees. Rolling into 30 degrees of bank while maintaining level flight results in the significant increase in AOA depicted on chart 5 above. Maintaining level flight and 340 knots, the wings are then swept aft from the 54 degree position until the aircraft will no longer hold altitude or airspeed at military power (position 3). Recovery is effected by moving the wings forward to 50 degrees, returning the aircraft to a safe flying AOA. A constant AOA turn while decelerating was added to this demonstration as a result of a recommendation from an FB-111A loss of control mishap investigation. Accelerate the aircraft to 400 KIAS, roll into a 60 degree bank level turn with a power setting insufficient to hold airspeed. When AOA reaches 12 degrees, sweep the wings forward to maintain that AOA while airspeed bleeds off.

**(FIGURE 8)**



This maneuver demonstrates that the pilot can maintain complete control of maneuvering AOA even while decelerating simply by sweeping the wings forward.

### Conclusion

I have discussed a few of the maneuverability demonstrations described in SACR 51-111. The following conclusions can be drawn from the article.

- By maneuvering the aircraft effectively throughout the flight envelope, the pilot develops an indispensable confidence in the machine. These maneuvers should be practiced as often as possible, particularly just prior to participating in a Red Flag or Maple Flag exercise.
- The most important flight instrument to monitor when max-performing the variable geometry aircraft is the angle of attack indicator. Instructors should stress an effective crosscheck of the AOA indicator and elevator position indicators both in-flight and in the simulator.
- Using "rule of thumb" or "seat of the pants" techniques for positioning the wings or flying the aircraft can lead to problems. To fly safely, the pilot must know exactly what he is doing and why.
- Regularly practicing the SACR 51-111 demonstrations will help keep the swing wing crew ready to perform its mission.

# SAC SAFETY SCREEN

The SAC Safety Screen is an honor roll of SAC's most professional crews. To gain listing on the Screen, crew members must be nominated by their unit commanders and meet high selection criteria of experience in their aircraft or missile system *IAW AFR 127-2/SS1.*

**46 BMS, Grand Forks Crew E-31:** P LtCol William Fitzpatrick, CP 1Lt Michael Walker, RN Capt Roger Gustafson, N 1Lt Steven McKay, EWO Capt Mark Ashton, G SSgt William Pangborn

**23 BMS, Minot Crew R-43:** P Capt Michael H Eastham, CP Capt William Westcott, RN Capt Dana H Atkins, N 1Lt Russell C Barnes, G SSgt Eric Snyman

**23 BMS, Minot Crew E-22:** IP Maj Paul S Castle, ICP Capt Arthur F McDaniels, RN Capt Joseph R Griffith, N 1Lt Kenneth R Dorner, EWO 2Lt Jeffery T Mineo, IG SrA James L Waldron

**5 BMW, Minot Crew E-31:** P Maj William Price, CP 1Lt Kirk Davis, IRN Maj Phillip Krasnicki, IN 1Lt Mark Hawks, IEWO Capt Alfred Sanchez, IG TSgt Jimmy Williams

**906 AREFS, Minot Crew R-120:** P Capt William L Craine, CP 2Lt Wayne E Howe, N 1Lt Martha Y Stevenson-Jones, IBO SSgt Michael E Kramer

**906 AREFS, Minot Crew E-107:** P Capt Douglas A Salter, CP 1Lt Curtis I Brake, N 1Lt James D Keels, BO SSgt Dennis J Hillberry

**524 BMS, Wurtsmith Crew E-32:** AC Maj Fred A Mayer, CP 1Lt Theodore K Pounds, RN Capt David A Gibson, NN 1Lt Robert J Hand, EW 1Lt Thomas D Meyer, AG SSgt Paul R Fultz

**920 AREFS, Wurtsmith Crew R-153:** AC Capt James J Geery, CP Capt Gordon R Jessie, NN 2Lt Bruce N Grygier, BO SrA Allen E Kaczor

**920 AREFS, Wurtsmith Crew R-135;** AC Capt Charles P Modrich, CP 1Lt Marion T Fuller, NN Capt Natalie M Spradling, BO SSgt Jon M Bibler

**340 BMS, Blytheville Crew E-20:** AC Capt Eldon L Ely, CP Capt Marcus R Drinkwater, RN Capt Michael R Godbey, NN 1Lt Wallace A Penn, EW 1Lt James D Osborne, AG SSgt Michael D Moore

**340 BMS, Blytheville Crew R-23:** AC Lt Col Adolph A Valfre, CP 1Lt Thomas S Miller, RN Capt Stephen K Draper, NN 1Lt Douglas S Black, EW 1Lt Michael D Geasley, AG SSgt Samuel S Brucks

**97 AREFS, Blytheville Crew R-123:** AC Capt Craig Allen Greenfield, CP 1Lt Glenn H Tarsi, N 1Lt Curtis E Davis, BO A1C Brett A Howard

**97 AREFS, Blytheville Crew E-113:** AC Capt Gary Mills, CP 1Lt Alexander Bollman, N 1Lt John J Demaye, BO Sgt Robert L Wiggs

**28 AREFS, Ellsworth Crew R-106:** P Capt Ricardo Hernandez, CP 1Lt Richard J Heymans, IN 1Lt Lisa M Fisk, BO Sgt Charles T Ries

**4 ACCS, Ellsworth Crews S-102 and R-291:** MCCC-A Capt Larry S Brown, DMCCC-A Capt James E Long Jr, IP Lt Col Darrell W Sauder, CP Capt Gregory L Werking, IN Capt Evan H Ashby, IB SSgt Robert L Powers

**77 BMS, Ellsworth Crew R-34:** P Capt Michael E Ware, CP 1Lt Ted A Grant, RN Capt Steven C Kasemeier, N 1Lt Rory D Adams, EW Capt Robert M Namendorf, AG SSgt Normal K Holbrook

**77 BMS, Ellsworth Crew E-36:** P Capt Christopher J Patterson, ICP 1Lt Timothy J McClain, IRN Capt John Alfier, N 1Lt David G Smith, EW 1Lt Carry Capper, IAG Sgt Christopher M Brady

**99 SRS, Beale Crew:** Capt Joseph J Fusco, Capt Thomas D Dettmer

**1 SRS, Beale Crew E-14:** Maj Gary I Luloff, Maj Walter F. Nwegreen Jr

**349 AREFS, Beale Crew R-124:** Capt Leeroy A Martin, 1Lt Timothy D Christy, 1Lt Michael L King, MSgt James T Welby

**99 SRS, Beale Crew:** Capt Joseph F Mudd, Maj Daniel H David

UNIVERSITY OF FLORIDA
3 1262 09683 5953

FLARE

# HALL OF FAME

### OVER TWENTY-NINE YEARS

| | |
|---|---|
| 170 AREFG, McGuire (NJANG) | Feb. '56 |

### OVER TWENTY-SEVEN YEARS

| | |
|---|---|
| 171 AREFW, Greater Pittsburgh (PAANG) | Mar. '58 |
| 157 AREFG, Pease (NHANG) | Jun '58 |

### OVER TWENTY-SIX YEARS

| | |
|---|---|
| 940 AREFG, Mather (USAFR) | May '59 |

### OVER TWENTY-FOUR YEARS

| | |
|---|---|
| 151 AREFG, Salt Lake City (UTANG) | Feb. '61 |

### OVER TWENTY-THREE YEARS

| | |
|---|---|
| 134 AREFG, McGhee Tyson (TNANG) | Aug. 61 |
| 11 SG, Fairford | Feb. '62 |
| 340 AREFG, Altus | Jun '62 |

### OVER TWENTY-TWO YEARS

| | |
|---|---|
| 96 BMW, Dyess | Aug. '62 |

### OVER TWENTY YEARS

| | |
|---|---|
| 160 AREFG, Rickenbacker (OHANG) | Dec. '64 |
| 320 BMW, Mather | Jul '65 |

### OVER EIGHTEEN YEARS

| | |
|---|---|
| 452 AREFW, March (USAFR) | Sept '66 |
| 55 SRW, Offutt | Jul '67 |

### OVER SEVENTEEN YEARS

| | |
|---|---|
| 2 BMW, Barksdale | Aug '67 |

### OVER SIXTEEN YEARS

| | |
|---|---|
| 5 BMW, Minot | Feb. '69 |

### OVER FIFTEEN YEARS

| | |
|---|---|
| 141 AREFW, Fairchild (WAANG) | Oct '69 |
| 28 BMW, Ellsworth | May '70 |

### OVER THIRTEEN YEARS

| | |
|---|---|
| 101 AREFW, Bangor (MEANG) | Mar '72 |
| 306 SW, Mildenhall | Apr '72 |
| 416 BMW, Griffiss | May '72 |

### OVER TWELVE YEARS

| | |
|---|---|
| 305 AREFW, Grissom | Aug '72 |
| 379 BMW, Wurtsmith | Apr '73 |

### OVER ELEVEN YEARS

| | |
|---|---|
| 931 AREFG, Grissom (USAFR) | Feb '74 |
| 384 AREFW, McConnell | Mar '74 |
| 189 AREFG, Little Rock (ARANG) | May '74 |

### OVER TEN YEARS

| | |
|---|---|
| 43 SW, Andersen | Dec '74 |

### OVER NINE YEARS

| | |
|---|---|
| 68 AREFG, Seymour Johnson | Sep '75 |

### OVER EIGHT YEARS

| | |
|---|---|
| 410 BMW, K.I. Sawyer | Apr '77 |
| 190 AREFG, Forbes (KSANG) | Apr '77 |
| 128 AREFG, Milwaukee (WIANG) | Jul '77 |

### OVER FIVE YEARS

| | |
|---|---|
| 376 SW, Kadena | Aug '79 |
| 7 BMW, Carswell | Jul '80 |

### OVER FOUR YEARS

| | |
|---|---|
| 319 BMW, Grand Forks | Sept '80 |
| 380 BMW, Plattsburgh | Oct '80 |
| 97 BMW, Blytheville | Jan '81 |

## ICBM

### OVER TWENTY YEARS

| | |
|---|---|
| 1 STRAD, Vandenberg | Sept '64 |

### OVER FIFTEEN YEARS

| | |
|---|---|
| 341 SMW, Malmstrom | Apr '70 |

### OVER TWELVE YEARS

| | |
|---|---|
| 321 SMW, Grand Forks | Aug '72 |

### OVER TEN YEARS

| | |
|---|---|
| 351 SMW, Whiteman | Oct '74 |
| 91 SMW, Minot | Nov '74 |

### OVER SIX YEARS

| | |
|---|---|
| 381 SMW, McConnell | Aug '78 |
| 44 SMW, Ellsworth | Nov '78 |

### OVER FIVE YEARS

| | |
|---|---|
| 90 SMW, F.E. Warren | Dec '79 |

### OVER FOUR YEARS

| | |
|---|---|
| 308 SMW, Little Rock | Sept '80 |

To gain listing in the Hall of Fame, a SAC or ARF unit must be Class A mishap-free for 48 months.